PUBLIC LIBRARY

AMERICAN MACHINIST

A JOURNAL FOR MACHINISTS, ENGINEERS, FOUNDERS, BOILER MAKERS, PATTERN MAKERS AND BLACKSMITHS.

VOL. 14, No. 28. WEEKLY. | NEW YORK, THURSDAY, JULY 9, 1891. | $3.00 per Annum. SINGLE COPIES 6 CENTS.

COPYRIGHT 1891, BY AMERICAN MACHINIST PUBLISHING COMPANY. For Sale Everywhere by Newsdealers. ENTERED AT POST OFFICE, NEW YORK, AS SECOND CLASS MATTER.

Double-cylinder Hoisting Engine.

We give on this page some illustrations of a hoisting engine, in which there are several new features worthy of attention. The sectional view above is not made from the same engine, but from another type by the same manufacturers, it being given here in order to make plain the method of supporting the cylinders, and of effecting the steam distribution.

The perspective view is of a double-cylinder engine, intended especially for the use of railroad and bridge builders, or for use in quarries, on docks and aboard ships, for pile driving and general hoisting purposes.

The cylinders are oscillating, placed one at each end of the crank-shaft, and the entire machine is self-contained; the frame proper being a single casting, so, that when the engine is lined up and adjusted at the shops, it is ready to run upon attachment of the proper steam pipes.

The throttle valve is balanced with a view to prompt and convenient handling, and all necessary brakes are provided, by which the motion of the load is under complete control.

A cone friction is used between the winding drum and the main gear, seasoned hickory being used for the frictional surface, and the arrangement is such that, when the friction is thrown in, no lateral strain is thereby imposed upon the frame of the machine, but it is confined to the shaft upon which the drum is placed.

There is a band brake for lowering, worked by the foot lever shown, which can be placed at either side of the engine.

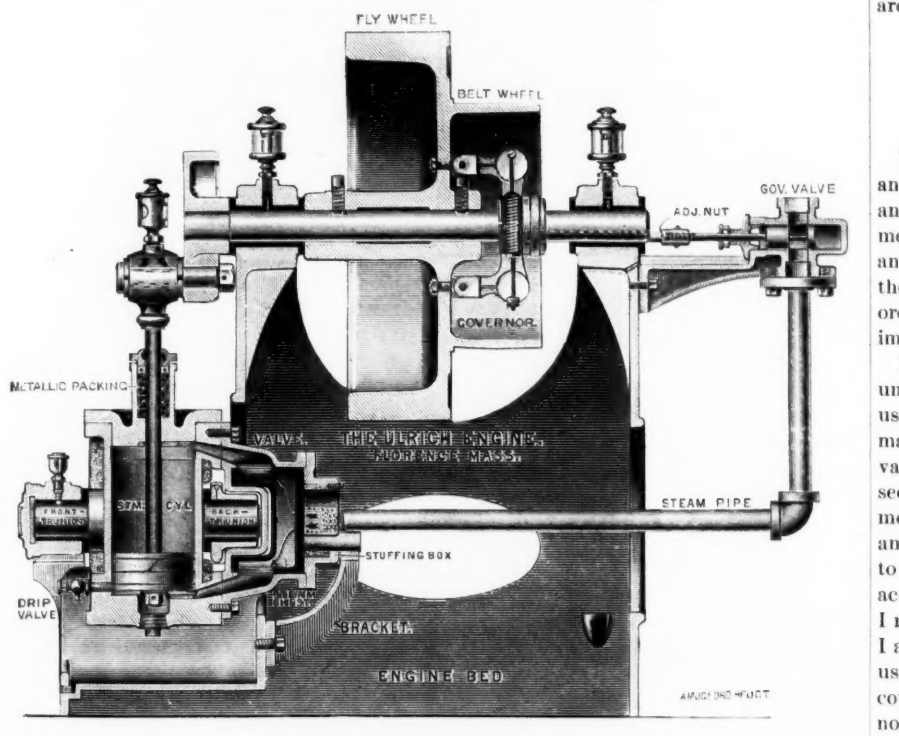
Pains have been taken in designing this engine to avoid all projecting parts which are liable to be knocked off in moving the engine about, as it is frequently necessary to move it about for some of the work for which it is designed.

Where it is desired, the base is extended and a boiler is placed upon it.

By reference to the sectional view it will be seen that the cylinder is supported upon trunnions which are not used in any way for the admission of steam. The steam chest is cylindrical in form, and has port openings above and below the trunnion. These openings are in the cylindrical surface, and the valve which is attached to, and consequently moves with the cylinder, has corresponding openings, the whole arrangement being such that the clearance space is much reduced, and there is no pressure of steam tending to crowd the cylinder over towards the opposite trunnion. There is also a complete balancing of the steam pressure, so far as the valve operation is concerned, and thus durability is secured, and steam-tight joints easily maintained.

The single-cylinder engine is intended for the general purposes of power furnishing, and is equipped with the form of governor shown, which is simple and direct in its action, controlling speed by means of the balanced valve shown, and there is no belt for driving it.

The hoisting engine is built in six different sizes, with cylinders 4″x5″ up to 7½″x12″, and with nominal lifting capacities from 1,000 to 5,500 pounds, by the Ulrich Engine Co., Florence, Mass.



DOUBLE-CYLINDER HOISTING ENGINE.

Owners and users of machinery in Great Britain continue to agitate the matter of what is there known as "machinery rating," which means assessment and levying of taxation. They are thoroughly convinced that unfair burdens are laid upon them in the way of taxation, and are evidently determined to keep up their efforts to have them removed. Our English exchanges continue to publish communications from machinery men and others, in which the injustice of burdening enterprise and industry by unfair taxation is being shown in a very clear manner. The conviction seems to be growing there as well as here that the workers of the world are not fairly treated in regard to taxation, while the drones and monopolists are especially favored in this respect.

The Use of the Slide Rule.

BY COLEMAN SELLERS.

While spending many months in England and on the Continent of Europe, and having an opportunity to notice the difference of methods that obtain among engineers there and here, I was very forcibly impressed with the constant use made by engineers of the ordinary carpenter's slide rule in some of its improved forms for all ordinary calculations.

Many times in my own experience have I undertaken to acquire some facility with the use of this instrument, but failed to either master its use or to fully appreciate its advantages, if it possessed any. However, seeing such constant use made of the instrument in one or the other of its several forms among engineers abroad, I felt constrained to study it more carefully, and if possible to acquire some facility in its use, in order that I might judge the better of its practicability. I acknowledge that in my first attempts to use the slide rule I certainly did not feel encouraged to go on with the work. It was not until I saw it presented in a very portable form in London that I was led to exert myself more diligently to acquire the habit necessary to use it with facility.

There is in quite common use, particularly in England, one form of the slide rule that goes by the name of Boucher's Calculator, manufactured by some of the instrument makers in London. The one before me has the name of Manlove, London, upon it, but my impression is that Stanley, of Great Turnstile, London, is probably the only maker of this form of instrument at present.

It is no larger than an ordinary watch, $2\frac{1}{16}$″ diameter, with open face, back and front. It has a stem-winding attachment; turning the button within the guard ring the dial of one face is caused to rotate by gearing contained within the case. Holding this instrument in front of you with the stem-winder above a second button placed to the right hand, about where two o'clock would be on an ordinary open-face watch, the guard ring being at the hour twelve, this second knob causes two pointers to revolve, which are riveted to the central axis. These pointers are coincident front and back; that is, the pointer or hand on the face turns conjointly with a similar pointer on the back.

Turning the instrument over to view the back of it, the dial is there found to be entirely stationary, the only movable object being the pointer operated by this button to one side.

Upon the front dial are engraved four concentric graduated circles, the outer circle being the logarithms of the sines of angles, as found on an ordinary slide rule. Inside of the circle of the sines of angles is the principal working circle, or scale of ordinary numbers of the instrument, that of the scale of logarithms from one up to ten, which is, in reality, $1\frac{7}{16}$″ in diameter, and if straightened out would be about 4¼″ long, nearly as long as one of the

upper scales on the ordinary 10″ Gravet slide rule. Inside of this circle of the logarithms are two, which together make up the length of the scale capable of expressing the squares of the logarithmic scale, in which 2 on the inner scale corresponds with 4 on the logarithmic scale, and 3 would correspond with 9 on the scale of logarithms.

The stationary dial on the back of the instrument has in its larger circle the decimals of the logarithms expressed on the second of the scales in front, while three other circles within this correspond to the cubes of the logarithmic scale. Thus, if the movable dial on the front be set to 27 when 1 is at the fixed pointer, the movable pointer on the back of the instrument will stand at 3. This shows that the figures on the back express the cube root of the numbers on the face of the instrument.

This short explanation of the instrument will enable the reader to appreciate it.

"The logarithms on this little instrument are represented upon the dials of the circle by arcs, which all have the same starting point, and are fractions of the entire circle, proportional to the logarithms themselves." The logarithm of 1 being zero, is, of course, the starting point of the arcs marked 1. The logarithm of 2 coincident with 0.30103 is represented by the arc 1 to 2, comprising 30,103 parts of the circle spaced, to be divided into 100,000 equal parts, and so with the logarithms of the other numbers up to 9, the logarithm of 10 again coinciding with 1, is thus represented by one complete circle. Each time that the circle is read, continuously advancing, the value becomes ten times greater; thus, once around this arc up to 1 is from 1 to 10, then the next time from 10 to 100, and the next reading would be from 100 to 1,000, and so on.

The shortness of this circle would prevent, one would think, its being used for any but the simplest calculations, but this is not so, for a little practice gives one the facility to estimate the value with wonderful precision, even up to three and four figures; but the great advantage of the use of the instrument to those who have made themselves familiar with its practice is that quite elaborate calculations can be worked out with a degree of accuracy that is surprising.

In calling the attention of the readers of the AMERICAN MACHINIST to this little instrument I do so mainly in the hope that the English makers will so place the instruments as to be accessible to American purchasers, or, failing to do this, that some enterprising American house will supply the demand that must arise for an instrument of this character when its value comes to be appreciated. Having publicly called attention to the instrument since my return from Europe, and having been repeatedly asked for information as to where they may be procured, I take this means of answering the question to all who may desire to supply themselves with this form of calculating machine.

There are those, in England especially, who have made quite a study of the slide rule, and some very ingenious improvements have been introduced and instruments made that will read up to four or five numbers visibly, as, for instance, the spiral slide rule, the scale of which, if straightened out, would be equivalent to an ordinary slide rule of over 84 feet in length, and yet its spiral form of scale wound about a cylinder results in giving an instrument that may readily be held in one hand and manipulated with the other.

A noted engineer in England, in a lecture some time ago on this very subject, made the statement that, in his opinion, it was well enough for every one to learn the rules of arithmetic, but that as soon as they could possess themselves of machinery and instruments that were capable of taking the place of the slower methods of calculating, they would do well to substitute mechanical calculation for the memorized rules.

In order to enable those who are inclined to apply themselves to the use of the slide rule in one of its many forms, I would strongly advise them to set themselves diligently to mastering its use, not by occasional study of the instrument, but by such close application as to enable them to fully understand its use in one or two days' practice.

In some of the English pocket-books for engineers, as, for instance, Molesworth's, under the head of slide rules, in the index, page 684, of the last edition, will be found concentrated upon two small pages a very clever set of rules for the use of the ordinary slide rule, in which the scales are marked *A*, *B*, *C* and *D*, *A* and *D* being fixed, and *B* and *C* being the scales upon the slide bar of the rule. This concise description of method has a well-arranged table of fourteen different processes from multiplication, division, proportion, inverse proportion and mensuration of solids, etc., expressed in a manner that makes it particularly easy to retain in the memory the several steps that are to be taken in arriving at a conclusion.

I wish particularly to call attention to the fact that it is in early life that the mind can more readily acquire the habit of thought which is necessary to use an instrument of this kind, and I would urgently direct the thoughts of young engineers toward the use of this or similar instruments while they have the ability to apply themselves carnestly to the line of study.

Those who may feel discouraged at first in regard to the use of the slide rule, in any of its forms, should allow no discouragement to stand between their first attempts and success in the use of it, as there comes a time when, by diligent application to a study of this nature, the various steps that must be taken become a fixed habit, and the use of the instrument is then automatic.

In simple calculations like that of determining the horse-power of a steam engine from the indicator card, the slide rule is particularly useful. From the examination of the card itself a mean pressure is found. The diameter of the cylinder gives the area upon which the steam acts. The area can be read from the scales on this instrument with great readiness. It does not, in this portion of the calculation, become necessary for the area to be read to the second, or third, or fourth point of a decimal; it merely becomes necessary to note where the pointer stands in relation to some graduated mark of the scale. What the value is, is a matter of no moment whatever, so far as the result of the calculation is concerned, except in deciding the position of the decimal point. The number of the strokes of the engine, and the length of the stroke, give the speed in feet per minute. Knowing the area, as expressed by position on the scale, also the mean pressure of the steam per square inch, and the piston speed per minute, the process with the Boucher calculator is to bring the movable dial with 1 under the fixed pointer, then to set the movable pointer at 33, which is the denominator in the formula —area of piston multiplied by mean pressure, multiplied by the piston feet per minute, and divided by 33,000, equals the indicated horse-power of the engine, regardless of friction.

It is the best practice with the Boucher calculator, as well as with the ordinary slide rule, to make the first setting to the fixed index, and all other settings to the movable index. This will result in bringing the answer sought under the fixed index, with a certainty in regard to method that leaves little to be remembered, but makes an orderly sequence of movements which greatly facilitates the use of the instrument.

In the present case, taking as an example a 16″ cylinder, the mean pressure having been found to be 41½ pounds per square inch, piston speed 400 feet per minute, the instrument will give, by one operation, the area of a 16″ cylinder as 201 about. Noting the position of this 201, or whatever the exact amount may be in relation to the pointer, its exact amount is disregarded. Then the order of proceeding is to place 1 of the movable dial under the fixed index at the top of the instrument; set movable pointer to 33; bring 201 on the movable dial under the movable pointer; set movable pointer to 1 on dial; bring 41½ on dial to the movable pointer; set movable pointer to 1 on dial; bring 4 on dial, which represents 400 piston feet per minute, under the movable pointer, and under the fixed index will be read 101 horse-power, which is the indicated power of the engine.

This gives an example of an operation often required by engineers, and points to the facility with which quite elaborate calculations may be continuously worked out, regardless of the value of the intermediate steps between the first movement of the dial and the final reading at the index.

The practical use of the slide rule can be most readily acquired by a careful study of what constitutes the several operations required in mathematics, such as multiplication and division, when the mind will come to appreciate that every operation is some form of proportion, and the slide rule is eminently an instrument for proportional comparison.

To explain what I mean, the multiplication of 2 by 4 can be expressed by the fraction $\frac{2 \times 4}{1}$, and the division of 4 by 2 can be expressed by the fraction $\frac{1 \times}{2}$. In the operation quoted above, of the indicated horse-power of a 16-inch cylinder at 41½ pounds mean pressure per square inch, there were a certain number of movements all in orderly sequence, and the mind has no difficulty in tracing these when one recollects that the equation must be expressed in such a manner that all the movements of the movable pointer in relation to the dial shall be expressive of the value of the denominator of the equation, while the movements of the dial to the pointer after the first setting of the instrument are to the numerators of the fractional equation. With this operation in mind, the use of the instrument becomes exceedingly simple, and there is very little likelihood of mistake being made. In regard to the final result, in nine cases out of ten the familiarity of the equation and the approximate result aimed at leave little doubt as to the number of figures in the answer, or, in other words, the position of the decimal point; but the directions that usually accompany these instruments give rules which will at once enable the operator to determine the position of the decimal point without any fear of mistake.

In this short article it is not my intention to give a lesson on the method of the slide rule, though, should any readers of the AMERICAN MACHINIST desire such information, I would gladly place in these pages a summary of the method used by myself in acquiring some facility in the use of the instrument. Having mastered the difficulties of the slide rule late in my own life, after having almost despaired of being able to use it with any degree of satisfaction, I would only say that those who would do as I did—put their whole mind on the subject for the time being—would have much less difficulty than I experienced in acquiring facility of manipulation, when the mind has fewer subjects to dwell on than is usually the case later in life.

Having occasion some few months ago to read and translate a number of papers in which the dimensions were all expressed in metrical nomenclature, and it being essential to convert the same into feet, inches, or other English equivalents, I found the task very much lightened by the use of several slide rules, each set to the value of the measurement to be converted, whether from meters into yards, meters into feet, or kilos per square millimeter into pounds per square inch.

A further use may be made of the slide rule in all business operations, whether the result to be obtained is in money value or dimensions of matter. Frequently cases arise in which the user of the instrument will light upon shorthand methods of proceeding. Having in one case partially worked out a formula that may be applied to various quantities, we will remember or make note of what position the pointers and dial had at the end of steps that would be in common in the same formula with change in one value only. As, for example, to find the number of cubic feet of water per minute per H. P. for any given fall, on the assumption that the turbine or water motor will yield 75 per cent. efficiency, my method of proceeding is to place $14\frac{1}{10}$ on the movable dial under the fixed index, setting the pointer to 1 of the movable dial; I then bring under that pointer the fall or head given, say 140, which would be represented by 14 moved under the pointer; then setting the pointer to 1 of the fixed dial, I bring back 1 under the fixed index and read the result, 5.1 cubic feet at the movable pointer, which is contrary to the usual rules, but is permissible in this case, on account of the nature of the formula used. Thus, for any given head, with the least effort possible, the quantity of water required per minute per horse-power is arrived at without any tax on the memory of carrying in the mind the quantities relating to various heads or falls.

The constant use of the slide rule has another advantage, and that is that it schools the mind in habits of thought and methods that enable those who are not naturally gifted as mathematicians to come to a fair knowledge of the value of figures.

I do not know how it may be with others, but in my own case I have always found that the power of memorizing depends greatly upon the exercising of that power, that even seemingly useless efforts of memorizing are better than none at all, as giving healthy exercise to faculties which would become dormant if not kept in active use. He who in youth can memorize with facility either figures or words can only continue that kind of mental exercise by keeping up the practice. It is lost by non-exercise.

The slide rule then presents itself in regard to figures as a mode of memorizing in which to the mere figures themselves is added their fixed position in regard to a certain instrument, and the effort of memorizing is very much facilitated when some object is brought to the mind associated with the thing to be remembered. This, however, opens up too deep a subject, and would lead me away from the slide rule, intended to be the subject of this letter.

In the shipyard at Dunbarton, Scotland, I was shown one room where over twenty men were engaged on calculations and tabulation with the slide rule of the spiral type as their sole means of working.

A skillful engineer in London, who has made the use of this instrument almost his "fad," and a good one too, has contrived an ingenious instrument attached to his desk, in which a steel endless band carefully graduated is made to pass over pulleys with a twist in the band, where it passes below the desk so arranged as to utilize both sides and both edges of the metal band for the graduated scales.

Good use has been made of the mechanical calculator in the United States by some persons, and well made and effective modifications of the slide rule are on the market. The simplest form, however, as worked out by instrument makers, is what lends itself to popular use, and it is to the slide rule in its simplest and yet most improved form that I now call attention, in the hope that it will be introduced into the course of instruction in the technical schools.

Sir John Hawkshaw, who recently died in England in his eighty-first year, was a remarkably industrious and successful engineer. At the age of twenty-one he undertook the management of large copper mines in South America. Returning to England three years later, he occupied the position of engineer for some of the large railway and canal companies there, and was from that time on connected with much notable engineering work. Undoubtedly his greatest work was the Severn tunnel. This was under construction for thirteen years, and its successful prosecution and completion was in a large measure due to his skill and perseverance.

Prof. A. T. Wood, who is well known to our readers, has resigned his position as professor of mechanical engineering at the University of Illinois to take a similar position in the Washington University, St. Louis, Mo.

Boiler Makers' Drill Press.

On this page we illustrate a drill press designed especially for the use of boiler makers, bridge builders and structural iron works generally, where the work is so large as usually to require some special form of table or support while being operated upon.

It will be perceived that the machine is proportioned and built with special reference to strength and rigidity. It is intended for the heaviest and roughest work found in shops, and the frame, spindle, gearing, etc., are designed to stand it.

The spindle has a vertical movement of 11″; is $3\frac{5}{8}$″ diameter below, and $2\frac{5}{16}$″ above the sleeve, and its center is 36″ from the post. There is a four step cone for a $3\frac{1}{4}$″ belt, the largest step of the pulley being 14″ diameter. This, with the back gears and bevel gears, gives great driving power, while a powerful feed is had by means of worm gearing.

The hand-wheel for the feed is extended out in front, as shown, so that it can be easily reached by the operator when he is working on a large sheet, where it would be difficult to reach the feed-wheel if located at the side of or close to the spindle.

The manufacturers are the Lodge & Davis Machine Tool Co., Cincinnati, Ohio.

Pittsburgh Shop Notes.

(Editorial Correspondence.)

At the time of my visit to Pittsburgh, most of the shops were considerably demoralized by la grippe. The Pittsburgh Locomotive Works (in Allegheny) had been shut down by it for two days, every foreman except one, besides many of the men, being at home sick.

So far as the business of the company is concerned, this stoppage was not such a serious matter as it would have been had it occurred a short time before, for the demand for locomotives is not nearly so brisk as it was some time ago, and builders generally are getting something more of an opportunity to breathe.

A NEW OLD SHOP.

The Pittsburgh Locomotive Works is one of the many American shops that may be said to be new old institutions. Locomotives have been built here for many years, and yet the plant is to day practically a new one, the enlargements of buildings and additions to equipment which have been made within the past few years being now the predominating features of the place. This shop is doing what many other shops engaged on the heavier kinds of work are now doing, *i. e.*, adapting to their needs processes of manufacture which have in the main been previously used in the production of smaller machinery built in larger numbers. The processes are, however, somewhat modified to suit the character of the work in most cases, but one who is familiar with the process of manufacturing used in such work as sewing machines, small arms, etc., recognizes the fact that what is called the modern system of machinery manufacture is not so entirely new as many engaged in it seem to suppose, but is simply a clever, and, of course, creditable application of principles, which have for years been applied to the production of lighter work, the increased numbers in which it is now possible to build the larger machines making this application practicable.

SPECIAL FACILITIES.

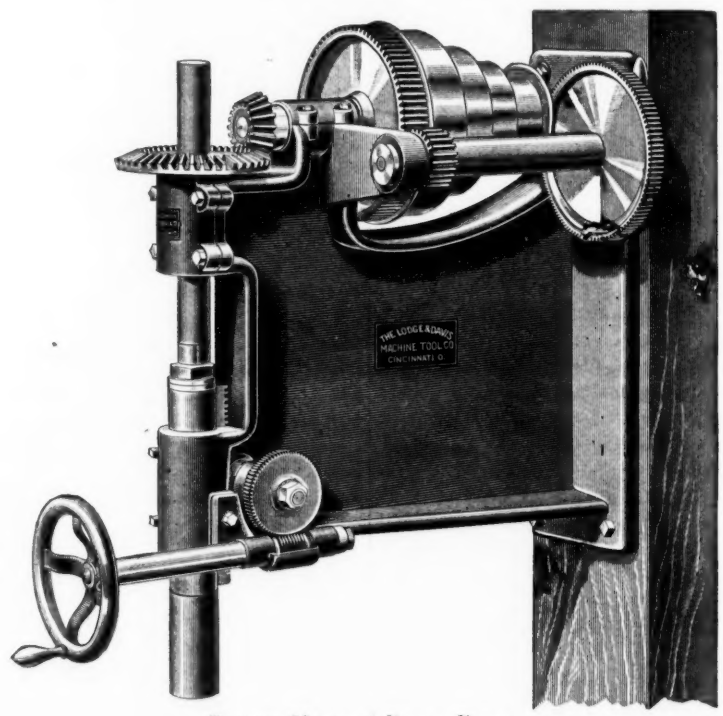
In the machine shop I did not observe that the methods employed differed very radically from what is now recognized as the correct thing in work of that class. Templates and jigs are used, so far as possible, in the work—templates and jigs which the average locomotive man would consider admirable, and the sewing machine or armory tool maker anything else. The reason for this, of course, is that the one would be comparing them with the old methods of doing work without any special facilities to speak of, beyond the regular machine tools, spring calipers, dividers, and a center punch; while the other would be comparing them with the elegantly finished tools and gauges used in the manufacture of guns. But the fact is that, from whatever standpoint they may be regarded, they serve their purpose, which is to facilitate the building of locomotives, and get a reasonable degree of interchangeability in the work.

Some of the machine tools, especially those which have been put in recently, are remarkable for their capacity, an instance of this being seen in a frame slotter, which will admit of four frames being placed top of one another and slotted together.

THE FOUNDRY.

In the foundry it is evidently the intention to have every facility known for doing the work expeditiously. There is a very interesting hydraulic crane, the various motions for which are derived primarily from an accumulator, and a wire rope leads from this back and forth across the building, and around innumerable sheaves and pulleys in a manner that is somewhat bewildering to one who attempts for the first time to trace it out from a position on the floor, though it does its work silently and efficiently.

There are also several molding machines from the Atlas Works, Indianapolis, that are used on such work as they are specially adapted to.



BOILER MAKERS' DRILL PRESS.

THE BOILER SHOP.

The boiler shop is equipped with the best modern tools, including a plant for hydraulic riveting. Hydraulic power is also used for bending wrought-iron work about the engines and tank frames, the machine which does this being of English manufacture, with a horizontal ram adapted to receive dies to suit the work.

PATTERN STORAGE.

The pattern storage building is one of the most admirable structures of the kind I have seen, and the system of storing patterns is excellent. The building, which is of some considerable size, is divided at intervals by solid brick walls which go above the roof, so that, if a fire should start in any division of the building, it could be confined to that department. The system of numbering patterns and the shelves upon which they are placed seems to be based on the principle of the numbers of the houses and "squares" in Philadelphia, *i. e.*, the number on the pattern indicates its location in the building. For instance, it would be known that if two patterns were wanted which were numbered 214 and 216 they would be found together on the same shelf, while one numbered 314 or 316 would be found on the next shelf. The shelves are built in racks or frames which extend from the floor nearly or quite to the roof, and above where the patterns can be reached from the floor there is a narrow platform which the locomotive man who accompanied me through the shops very naturally referred to as the "running board," from which the patterns above can be reached. Making the numbers on the patterns bear a fixed relation to the number of the shelf upon which they are placed is the unique feature of the system, however, and it works admirably, doing away with all necessity for book or other record keeping, and making the number of the pattern indicate at once its location.

REPAIRING.

Considerable repairing of locomotives is done here, the Carnegie interests, for instance, having something like twenty-five Pittsburgh engines which are kept in repair in this shop.

R. D. NUTTALL & CO.

The new shops of this company are also in Allegheny, and in them they are doing a class of work not so common in Pittsburgh or vicinity as in many other manufacturing cities.

SPECIAL AUTOMATIC MACHINES.

They undertake to build almost any kind of intricate and automatic machinery for accomplishing new things, or old things in an improved manner, and for this work are equipped with universal grinders and milling machines, etc., for doing first-class work. Some cork-grinding machines that I noticed in course of construction were remarkable for the high speed employed in one of the spindles, and for which it had been found that nothing but a ground journal would answer very well. The machines are used for forming the corks for champagne bottles; and another remarkable thing about them is that, though they are called cork-grinding machines, by the men who use them, they do not grind at all, the corks being cut to shape by very rapidly revolving cutters. Other intricate machines more or less out of the usual order in machine construction are made, including special sewing machines for manufacturing operations, and wrapping machinery which has been illustrated in our columns.

On the lower floor heavier work is done, and here is located the plant for the production of gearing for electric railway use. This includes a number of automatic gear cutters, and at the time of my visit they were just receiving a machine from Pratt & Whitney for milling the rims of the wheels, instead of turning them. This machine I gave some account of in our issue of November 20, '90.

At the time of my visit Mr. Nuttall was at home with a case of la grippe, and I missed seeing him. I saw plenty of evidence, however, that when he is on hand he is an active worker, though he devotes his time mainly to designing, and has a superintendent to look after the work in the shop. Though the establishment is not large (about 60 men are employed) the amenities of shop life are looked after in the way of conveniences for the men, and I was shown one room that is to be supplied with reading matter for them, and is to be open evenings.

THE CRESCENT STEEL WORKS.

Most machinists are unfamiliar with steel-making processes, for the reason that comparatively few of them have much opportunity to see steel made. This is true in my own case, and I consequently found considerable that was of interest to me in this, one of the best known establishments of its kind in the country, and, in fact, in the world. I shall not, of course, attempt to give any account of what I saw there that would be of much use to steel men, but such things as I saw there that were of interest to me—a machinist—I shall take it for granted that the machinists and tool makers reading this journal will be interested in a brief account of.

MAKING STEEL.

The process employed here is the well-known crucible process by which cast steel is made, and the main facts which impress themselves upon the mind of the superficial observer are the simplicity of the main features of the operation, and that by it totally different grades of steel can be, and are, regularly and intentionally produced within the same establishment.

In the first place, a definite quantity of iron is put into a flat, shallow pan made of sheet-iron. This is weighed in, and with it is put what is called the "medicine," *i. e.*, the materials—carbon, manganese, etc., which it is desired to have in the steel, these being also carefully weighed. The iron put into these pans differs widely for different steels, according to the grade or quality it is desired to make, that for the commoner and cheaper steels being of ordinary quality, though of course selected with reference to this use, while that for the finest and most expensive steel, such as is used in making the well-known "Crescent" polished drill rods, is the very best Swedish iron which is imported by the Crescent people for this purpose. The constituent parts and proportions of the "medicine" also vary according to the peculiar characteristics it is desired the steel shall possess, especially with regard to its temper, the word temper meaning to the steel maker practically the amount of carbon contained in the steel.

About 80 pounds of iron, with its "medicine," is put into a blacklead crucible that is covered by a lid, which, at the heat to which it is afterwards subjected, becomes practically air-tight.

A large number of these crucibles are placed in a furnace, which, in this case, is heated by natural gas, and in its general form resembles more than anything else a large trench lined with fire-brick, and having openings at the top at intervals covered by lids. Through these openings the crucibles are put in, and removed when the charge is melted. This removal is effected by means of tongs handled by a man who must stand nearly vertically over the opening, where he is subjected to the terrific heat pouring out of it, and yet he must work carefully and with a certain degree of deliberation, in order that the operation may be successfully performed. In order to stand the heat to which they are exposed, the men who do this work are swathed in woolen wrappings till they somewhat resemble Esquimaux in January; the cloths being kept wet, to prevent scorching. After being lifted out of the furnace the crucible is uncovered, and the contents poured into a cast-iron mold, which is made of two parts locked together, and called an ingot mold. These are of varying sizes, and the ingots, which are taken from them when cold, are again carefully heated in other furnaces, and then hammered into bars or other shapes.

The process of crucible steel making is a simple one, so far as its main features are concerned, and success with it depends largely upon the care taken with the materials used, and in the various processes of pouring to get a sound ingot and proper

heating for the subsequent hammering or rolling, etc. The crucibles usually last for only about four or five charges, when they must be renewed, so that they constitute an important item in the expense of making steel by this process. There are several crucible furnaces in the establishment, one of these being probably the largest in this country. It will hold 60 crucibles, each with a capacity for 80 to 90 pounds of steel. This furnace is heated by natural gas, as indeed are most of the furnaces used for various purposes about the establishment, an exception being in the case of those used for heating steel for sheet rolling, to which natural gas has been found for some reason not to be adapted.

HAMMERING AND ROLLING.

The hammering of the ingots into bars of finished steel is, of course, an operation requiring a skilled hammer man, and a great many of these are to be seen about the place working with all sizes and kinds of steam hammers. The rolling operations seem to be very much like those carried on in the ordinary rolling-mills, but much greater care is exercised in the rolling to keep the surface of the metal in good condition and free from oxide. Especially is this the case with the sheet steel such as is made in very large quantities for the makers of what are known as sections for harvesting machine knives.

TESTING.

Every lot of steel that is turned out is not only carefully made with reference to the purpose to which it is to be put, but the characteristics which it should have being known, it is, after being made, thoroughly tested in two different ways. The first of these is by means of the test which the steel will or, rather, should receive when it is put to use. A skilled steel worker forges a piece of it and tempers it, noting carefully its behavior at every stage of the process. This is then examined and further tested under the conditions for which it is intended. Besides this there is a chemical test. A very complete chemical laboratory is a part of the plant, and in this a piece of each lot of steel is subjected to a rigid chemical analysis. Usually the results arrived at by the steel worker and the chemist agree perfectly. That is to say, a steel which possesses the chemical characteristics that fit it for a certain purpose, or make it show certain peculiarities in working, is found to possess these qualities by the steel worker. And Mr. Metcalf says that in the few cases where these two tests do not agree it is the practice to repeat both tests, when it is invariably found that either the chemist or the steel worker has made some mistake in the first one, which is responsible for the disagreement.

A plant is being put in for the manufacture of open hearth steel, but not much was being done in this department at the time of my visit, beyond some experiments which were being conducted by Prof. John W. Langley.

POLISHED DRILL RODS.

One of the most interesting parts of the establishment is that devoted to the making of the polished drill rods before referred to. These are received in this department in the shape of rolled rods, which are drawn down and annealed at intervals in the usual way, the later stages of the operation, in the case of the larger sizes, being accomplished by what is rather a process of cold swedging than of drawing. The machine and process for doing this were invented by our correspondent, Mr. S. W. Goodyear. The machine consists essentially of a large disk revolving within a casing. This disk carries plungers which are arranged radially, and carry dies at their inner ends near the center of the disk. As the disk revolves, the outer ends of these plungers come into contact with the ends of pivoted levers, which by the motion of the disk have a toggle joint action, and force the plunger in towards the center with great force. The wire passes through the center of the disk between the dies, and is thus swedged to size. This is done in long lengths (by estimation, 25 or 30 feet) which are then straightened by being passed through an ordinary wire straightening machine, after which the wire is cut into lengths.

ENLARGEMENT BY STRAIGHTENING.

A curious feature in the manufacture of this wire is that it must be, when it goes to the straightening machine, somewhat smaller than its finished size, because it always enlarges during the straightening operation. The amount of this enlargement is known, and allowance duly made for it. For wire $\frac{1}{4}''$ diameter, the allowance made is nearly .001″, and it increases with the diameter of the wire. During the straightening operation, the wire is considerably heated by the friction and rapid bending, and its enlargement is attributed to this.

SOLD AS ENGLISH.

The makers of this wire always sell it, of course, for what it is, *i. e.*, a very high grade of steel of American manufacture made into wire by superior methods, securing uniform annealing, uniformity of diameter, straightness, and fine finish. It is well known, however, that a great deal of it is sold from hardware and machinists' supply stores as Stubs' wire to people who sincerely think they can use nothing but Stubs' for their work, and would be very much surprised and shocked to find that they had been using, perhaps for years, wire rods of American manufacture.

SPIRAL SPRINGS.

A good many spiral springs are made here, especially of the heavier kinds, such as are used in the trucks of railway cars, and for other purposes, some of them which I noticed being made of 2″ round steel, and the spring itself being 8″ diameter and 12″ long. The steel for such springs is heated in a furnace by natural gas, and there are special machines by which it is coiled about an arbor and dropped into the tempering bath of oil without reheating. All such springs are tested by means of a steam cylinder, which stands in a vertical position, and has attached to the upper end of the piston rod a plate upon which the spring is placed. Iron doors then enclose the spring, and steam being admitted, the spring is forced violently up against a fixed plate above it. This is done repeatedly in order to develop any weakness which may exist in the spring, and its length is carefully noted before and after the test.

Some idea of the size of the establishment may be had from the fact that about 500 men are employed, and there are about 30 boilers used for generating steam for use about the plant.

ELECTRIC TRACTION.

The top of what is called Observatory Hill, in Allegheny City, is reached by an electric railway, which is built up such heavy grades, and with such short curves, that one can hardly fail to have added respect for electricity as a motive power after riding upon one of its cars. And when we consider the number of foot-pounds of work which must be done in order to carry a passenger of moderate weight to the top of this hill, and that it is done for five cents, that respect is still further increased.

JOHN A. BRASHEAR.

At the top of the hill, however, is one of the most interesting establishments in the country to visit, provided the visitor is interested in witnessing the very finest mechanical processes known.

John A. Brashear started in life as a mechanic—a pattern maker. He studied his business and kindred matters, rising to the position of mechanical engineer, and occupying a position of responsibility in one of the largest and best known iron works of Pittsburgh. In his leisure hours he gave some attention to astronomy, and became an amateur astronomer of considerable skill. Being a mechanic, it was natural that he should have an ambition to construct some of the instruments with which he wished to make his observations, and those which he constructed were so excellently made that they attracted the attention of others wanting such instruments, who gave him commissions to construct them, and finally the orders of this kind became so numerous with his increasing reputation that he could fill them only by giving up his position in the iron works, and devoting his attention entirely to the production of instruments and apparatus used in astronomical work. It is only fair to say that I do not here quote statements made by him to me during my very pleasant visit with him. Mr. Brashear does not brag, and what is here said that is complimentary to him is based upon information obtained elsewhere, and what I myself saw of his work.

The particular branches of the work for which he is especially noted, and which it is safe to say he has developed to a higher degree than has been done before, are spectroscopes, object glasses for telescopes, and plane surfaces or mirrors upon which are ruled the marvelously fine lines which make what are called gratings, which serve to refract or separate light into its prismatic colors for spectroscopic work.

Many of his instruments, especially spectroscopes, are now in use by European astronomers and scientists, frequent shipments being made to Paris, and he enjoys the distinction of having made the spectroscope for Lick observatory.

FINE WORK.

The gratings referred to above have been brought to such a degree of perfection by him that one of them 2″ square is equal for spectroscopic work to 20 prisms.

Scarcely any work of art, and certainly no piece of fine jewelry can equal in beauty one of these plates—at least to the eye of the mechanic, who, besides seeing the beautifully brilliant colors reflected from its surface, is able to appreciate something of the highly refined processes by which it is produced. In the first place the alloy of which the plates are made must be very carefully compounded of the purest metals, that used here being made of 126.4 parts pure copper to 58.9 parts pure Banca tin. This mixture is called speculum metal, and it will take polish sufficiently high to receive the finest lines. These lines are ruled at Johns Hopkins University, and there are somewhat over 13,000 of them to the inch.

A TRUE SURFACE.

It is first necessary to get as near a perfect surface as possible, and this is accomplished by means of very ingenious machinery devised and built by Mr. Brashear. It is believed that surfaces are produced here in which the variation from absolute perfection is not over one millionth part of an inch. This magnitude is not, of course, measured directly, but the errors of a plate are detected by the application of a principle of the science of optics. If two surfaces be placed together (superimposed) the upper one being of glass, and both surfaces true planes; if then a ray of monochromatic light be passed through the upper plate to the surface of the lower one, this surface will appear to be illumed, but crossed with broad dark bands which, if the surfaces are exactly parallel at all points, are straight. But, if there is the slightest variation in distance from each other a bend will appear in the dark lines, and this variation needs only to be equal to $\frac{1}{20}$ of the wave length of the light used. These wave lengths have been determined by repeated experiments, and it is therefore known what the limit of variation of a plate must be, when, under this test, it shows straight lines. A plate which was being made at the time of my visit was shown me. At the time it was nearly true, but there was a perceptible deflection of the bands. As an experiment to show the small variation revealed by the bands, Mr. Brashear placed a finger on the upper plate; instantly there was the most violent movement of the lines, and they re-arranged themselves in an entirely different form, but after a time, as the small heat imparted by the finger became diffused, they returned approximately to their former shape, and, of course, given time enough, would return exactly. We all know that the disturbance of the accuracy of the surfaces by local heating, the heat being supplied by a mere momentary touch of the finger, must be almost infinitesimally small, but no one who sees the violent agitation of the lines under such circumstances can doubt but that this variation is easily detected, no matter how small it may be.

GRINDING OBJECTIVES.

Large objectives for telescopes are ground to shape by machinery designed by Mr. Brashear. In this grinding the glass rests in a horizontal position upon a piece of Brussels carpet, the fine points of which support the glass evenly all over, and prevent deflection by its weight. The lap is made of pitch, is formed to the curvature required, and placed on top of the glass, and rotated by a belt which drives a spindle to which it is attached. This spindle passes through a bar which is given a very complicated motion by means of two cranks, one at each end, to which it is attached. These cranks are of different (and adjustable) lengths, and rotate at varying speeds, so that the effect of all these movements combined is to thoroughly distribute the grinding over the surface of the glass.

TESTING OBJECTIVES.

During the earlier stages of the grinding the glass is tested by the spherometer, but the final test is that known as Foucault's. I cannot hope to make the description of this test as interesting to our readers as the test itself was to me, as I went through it with Mr. Brashear, but I can at least give an idea of what it is like, and the accurate results obtainable by it.

In a vault below the shop there is fitted up a room which is surrounded by double walls, air being admitted between them, and every precaution taken to exclude air currents from the room itself, and maintain an even temperature. No light is admitted from outside. At one end of this room there is a suitable support upon which can be placed a mirror, so that it will lie in a vertical plane, this mirror being made of speculum metal, and known to be a practical perfect plane. In front of this mirror is placed the lens which is to be tested, so that any light which passes through the lens will fall upon the mirror and be reflected back through the lens again. At a distance from the lens about equal to its focal distance is placed a stand upon which there is an ordinary lamp. Over the chimney of this lamp there is placed a shield of thin sheet metal, so that no light can escape from it except through some very small holes which are made for that purpose. There were in this instance three of these holes of varying sizes, the smallest being about .005″ in diameter. Through this small opening a ray of light goes to the lens, passes through it to the mirror, and is reflected back again through the lens. If now the eye be placed at a point near the small aperture from which the light is projected, the entire surface of the lens seems to be brilliantly illuminated, and this illumination is uniform over the entire surface. If the form of the lens is precisely correct all the light which falls on its surface will, after being reflected back through it by the mirror, be refracted so that at the focal point, which in this instance was about 10 or 12 feet from the glass, it will be gathered into a very small point of light, this point being the apex of a cone of light of which the lens is the base, and the focal distance of the lens the height.

Now a vertical straight-edge, mounted upon a suitable base which can be moved about easily by the hand of the operator, is placed on the stand near the lamp, and by a little experimenting, this edge, which is quite thin, is brought to the focal point, this position being known when, by the least movement laterally, it will shut off the view of the entire lens.

If any portion of the surface of the lens is not of precisely the proper form, the light reflected from that portion will fall outside of this small point at the focus, and that portion of the lens will appear black, simply because the light reflected from it does not reach the eye of the observer. The lens we were experimenting with was one which

had been nearly finished, and was about 12″ diameter. Placing my eye behind the straight-edge at the proper point, I saw the lens, its entire surface glowing with an even and bright light. By moving the straight edge about .01″ it disappeared as completely as though a screen close to the lens had been moved entirely across its face. Mr. Brashear now went to the lens, and by applying his hand to it produced disturbances in its surface, and in the air in front of it, by the heat of his hand. Touching the lens with his hand, every point of contact appeared black, and remained so for some time afterwards, the disturbance of the surface by expansion being sufficient to make the light coming from these spots fall outside the fine point at the focus, and consequently outside my vision. Even disturbances of the air were plainly seen, the current of slightly warmed air rising above the hand, refracting the light differently from the unheated air, so that the effect was plainly perceptible in the form of waves. We know, of course, that the deformation resulting from a momentary touch of the hand cannot be very great in such a lens, and the experiment shows that, however small it may be, it is readily detected.

A FELLOW-FEELING FOR AMATEURS.

Starting as an amateur astronomer himself, Mr. Brashear naturally takes considerable interest in the efforts of other amateurs, and makes it a special point of helping them to an outfit by which they can commence work. For a sum which is surprisingly small, considering the high quality of work furnished, he supplies all the optical work for a 5½″ reflecting telescope, and with it gives blue prints by which the amateur may do his own mounting. He exhibits with much evident satisfaction a number of photographs of telescopes which have been sent to him by amateur customers of his who have done their own mounting from blue prints thus furnished.

F. J. M.

Messrs. Clayton, Son & Co., Limited, gasholder and boiler makers, Moor End, Hunslet, Leeds, have just obtained an order for what will probably be the largest gasholder in the world. It is to be 300 feet in diameter and 180 feet in height, with no fewer than six lifts. The lifts will be peculiar in this respect, that the two upper ones will rise above the tops of the standards. The capacity of the holder will be twelve million feet, and it will require about 1,200 tons of coal to fill it with gas. For its construction 2,220 tons of metal will be needed —1,840 tons of wrought-iron, 60 tons of cast-iron, and 320 tons of steel. This immense holder is for the East Greenwich station of the South Metropolitan Gas Company. There were eleven tenders sent in for it, varying in amount from £54,000 to £41,195—that of the successful firm. The cost thereof will be about £3 10s. per thousand cubic feet capacity. Messrs. Clayton have undertaken to complete the holder by the 1st October next year. It is said that the largest gasholder existing is some 240 feet in diameter, and 150 feet in height.—*The Practical Engineer.*

The establishment of headquarters for engineers at the Chicago World's Fair was favorably considered by the mechanical engineers at the Providence meeting.

Best Northumberland coal at Newcastle, England, is quoted at 13s.—about $3.12.

A New Belt-testing Machine.

By GEO. I. ALDEN, WORCESTER, MASS.

(Presented at the Providence Meeting of Mechanical Engineers.)

A machine for testing belts should meet the following requirements: It should give accurately the sum of the belt tensions; the power transmitted, from which the difference of tensions can be readily found; the number of revolutions of the driving pulley; the number of revolutions of the driven pulley; and the number of runs of the belt during the trial, and also during any interval of the trial.

It should be capable of adjustment to a constant load, and to any load within the capacity of the belt it is proposed to test; to a change of load without changing the sum of the tensions; to any constant load with the sum of the tensions varied. It should give the arc wrapped by the belt on the driving and driven pulley and should record automatically the revolutions of the driving and driven pulleys and the runs of the belt.

The object of this paper is to describe a belt-testing machine, designed for the Engineering Laboratory of the Worcester Polytechnic Institute, and built at the Washburn shops. Much of the design is the work of Mr. Wm. W. Bird, formerly an instructor in the institute.

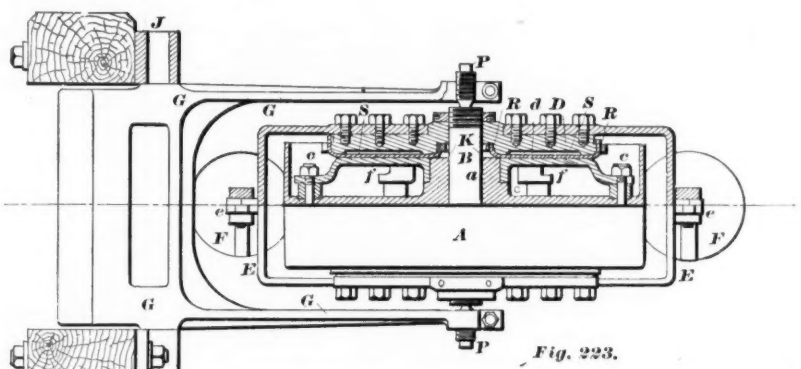


Fig. 223.

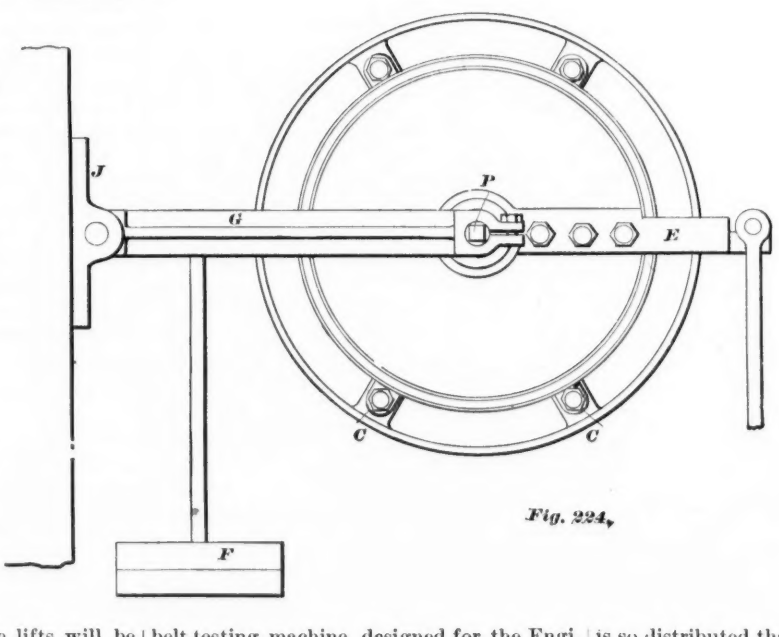


Fig. 224.

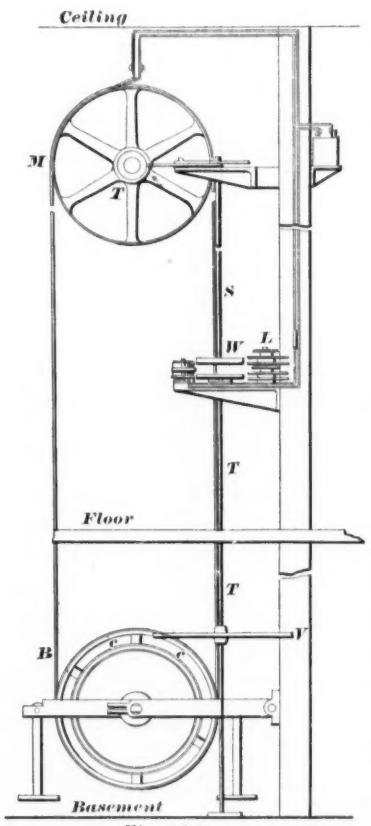


Fig. 225.

The peculiar features of the machine are:

First. The attachment to the driven pulley of an automatic absorption brake, made on the principle of the dynamometer, described on page 958, Vol. XI., of the Transactions of the Society.

Second. The method of supporting the driven pulley by which the weight of the pulley is taken by the tensions of the belt.

Third. The recording apparatus.

The construction of the absorption brake and its attachment to the driven pulley is shown in Figs. 223 and 224. Fig. 223 is a part sectional plan and Fig. 224 an elevation. The pulley *A* turns freely on the shaft *B*. The hub of this pulley is turned down at *a*, and a cast-iron piece *C* is bored out, fitted upon the hub, and bolted to the web of the pulley, as shown at *c c*. This cast-iron piece has its face *F* finished smooth. Another cast-iron piece *D* carries a copper disk *d*, which makes water-tight joints with the piece *D* by means of driven wrought-iron rings *R R*. Between the copper disk *d* and the cast-iron piece *D* is a space *S S*, to which city water is admitted through a pipe not shown in the drawing.

The forked arms *E E* are bolted to the piece *D* and carry projections *e e*, from which, by means of knife edges and rods, are suspended the pans *F F*, which receive the weights used to balance the load, this load being the friction between the copper disks *d* and the piece *C*. The pressure which causes this friction is produced and regulated by the admission of city water to the space *S*. The rubbing surfaces *f* are lubricated by the admission of oil to the cavity *K*, the oil being carried slowly over the surfaces from the center to the circumference by centrifugal force, making the lubrication perfect. The heat generated is carried off by allowing the water, which presses the copper disk against the surface of the revolving piece *C*, to circulate freely to the brake.

The pulley and its connected parts are supported by the belt, and in order to keep the axle of the pulley horizontal, a balancing frame *G* is provided. This frame is hung in adjustable bearings *J*, and its weight is so distributed that its center of gravity is on the axis of the bearings. Pins *p*, with conical ends, engage with the ends of the shaft on which the pulley revolves, in the manner shown in Fig. 223, so that while the balancing frame does not affect the weight which comes on the belt, it prevents oscillation of the pulley axle, and at the same time allows the pulley to adjust itself to the stretch of the belt.

Fig. 225 is an elevation of the machine, in which *M* is the driving wheel and *B* the driven pulley. The speed of the driver may be varied in any usual way. *S* is a shaft which receives a slow positive rotary motion from the shaft of the driver by means of a worm *T* and a train of gearing.

The shaft *S* carries a wheel *W*, having at uniform distances on its face sharp points, by means of which the revolution of the wheel gives a positive motion to a strip of paper, which is thus transferred from the spool *L* to another spool just behind *L* (Fig. 225), the paper being kept at a constant tension by means of small weights, which, acting upon cords wound around the spool axles, actuate the spools. The sharp points in the face of the wheel *W* leave prick-marks upon the paper, the distance between two consecutive marks representing 50 revolutions of the driver. Upon one element of the face of the wheel *W* is a pair of points which serve to mark on the paper a length equal to the circumference of the wheel *W*, this length representing 600 revolutions of the driver.

A pencil *P* carried by an arm *l*, and pressed by a spring against the paper, as it moves with the face of the wheel *W*, records a line on the paper. As often as a certain point in the belt passes a given fixed point, the pencil is actuated by an electro-magnet, and records a notch in the line upon the paper.

The number of revolutions of the driven pulley *B* are recorded in a similar manner, except that, as the driven pulley revolves on its axle, rotary motion is communicated to the shaft *T* by a cam *c* in the rim of the driven pulley, which cam operates a click which engages with a toothed wheel *V* upon the shaft *T*.

The machine is operated as follows:

The belt being adjusted upon the pulley, weights are placed in the pans, which, together with the weight of the machine, constitute the sum of the belt tensions.

These weights are so distributed in the two pans as to give the desired load.

Power is applied to the shaft of the driver and the machine attains its normal speed.

The city water is then admitted to the brake in the driven pulley, and is so regulated, either by an automatic valve or by an attendant, as to cause the friction of the brake to balance the weights in the pans.

The experimenter, standing near the recording apparatus, holds his watch, and at the instant he desires to begin the test, turns a switch and notes the time. During the test a button may be pressed at regular intervals, and a mark recorded. These marks divide the whole record into any desired number of sub-records, each complete in itself, but representing a shorter run.

The object of making these sub-records is to ascertain whether the total slip for the trial is uniform or intermittent.

The test is closed by throwing out the switch and noting the time. The two records are then examined and the data obtained may be written upon the ends of the ribbons, which are coiled and filed away for future reference.

In summarizing the advantages of the machine it may be noted:

First. That it requires no calibration except the weighing and measuring of the parts.

Second. It has no errors except such as are due to imperfect construction, and these may be reduced to any desired minimum.

Third. It does not require, during the trial, observations in which the errors of the personal equation of the experimenter are included.

Fourth. The axis of the driver being virtually above that of the driven pulley, the arc wrapped by the belt on each pulley can be accurately determined.

Fifth. It furnishes a complete and accurate record of the pulley revolutions and belt runs, from which the slip of the belt on each pulley may be computed.

Sixth. It has but few parts, and is operated with ease and convenience.

The discussion of the results obtained by experiments with the machine is reserved until more abundant data have been obtained.

It is said that the product of gold in the United States during the past 16 years is $572,900,000.

LETTERS FROM PRACTICAL MEN.

Large Upright Boilers.

Editor American Machinist:

R., Chicago, Ill., writes in the AMERICAN MACHINIST of May 28th for information on vertical boilers. He says they are claimed as capable of evaporating 12 pounds of water per pound of coal.

Such an evaporation is quite a top figure for the very best boilers, and one which has never come as yet under my personal notice, if it ever has been done. Still it is very probable that many upright boilers will at least dispose of so much water per pound of coal. They do not do so, however, by evaporation, but by violent ebullition. In fact, they prime.

Vertical boilers have their advantages. They are exceedingly useful for traveling cranes, builders' derricks, and temporary purposes generally, or for small powers, but they have special disadvantages also, not the least of which is the small water area per foot of fire-box surface. The locomotive boiler has the same fault in the region of the fire-box, but this is counteracted by the barrel extension, wherein water carried up by violent ebullition is deposited. In the vertical boiler it goes straight up to the steam pipe, and gives a fictitious appearance of evaporative efficiency. Large vertical boilers have been much used in English iron-making districts, to utilize the waste heat from several surrounding puddling furnaces. They are known as Rastricks, from their originator, and occupy little floor room, but are of great height. They have caused some of the worst explosions we have had, for the lower end plates become badly wasted by the direct impingement of highly heated gases and flame, and often corroded by leakage settling in and damping the brick seating, and Rastricks are now much distrusted.

There is a peculiar fault in small vertical boilers, which has caused many explosions: they corrode by internal grooving, in the narrow water space between shell and furnace, of the shell all around at the junction of the bottom ring, as shown in section, Fig. 1, such grooving seeming to be due to rigidity of the connecting ring or mud ring, as it is technically termed. Hence the alternative design of Fig. 2.

The grooved plate has often given way all round, and then the boilers go up like rockets, and I have seen them go over a stream and a high row of houses. Of late years, too, suspicions have been aroused that the furnaces of small vertical boilers are not so strong as they have been assumed to be.

There is of course a heavy load of steam pressure on their crowns, and as the uptake to which the crown hanger goes through the steam space, and so gets badly corroded, the furnace crown may lose its support, and collapse may ensue. It is now considered advisable always to place an internal lining in the uptake, as in Fig. 3, filling the space between the liner and uptake with fire clay, so as to screen the uptake from the fire. The small water surface and steam space of these boilers renders them unsuitable for steady work. They soon lose pressure. They are also excessive smoke producers with bituminous coals, their construction being highly unsuitable for perfect combustion. Some time back a sketch of a smokeless vertical boiler was given by me in the AMERICAN MACHINIST, showing a simple plan for improving this fault. In more recent tests of steam boilers, a new item may now usually be found, namely, the mean rate of travel of steam through the water. That is, simply the rate of steam production per square foot of water surface.

A comparison of the vertical boiler with a horizontal boiler of equal internal capacity reveals an enormous difference in this ratio, to the disadvantage of the vertical type, and serves to explain apparently high duty. Five to six pounds per pound of coal is probably quite a large evaporation with most verticals.

The annexed sketch is of a Rastrick boiler which exploded some years ago at an iron works. It received heat from four puddling furnaces at its base; the flames then passed up the side of the boiler in four vertical flues, and finally entered four openings, a communication with an inner tube down which they passed to the chimney by an underground flue *f*.

This boiler was 27 feet high, 10 feet diameter, had 4 branches of 2 feet diameter,

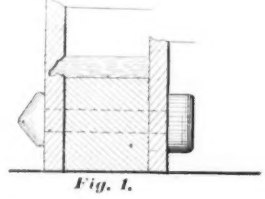


Fig. 1.

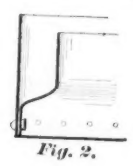


Fig. 2.

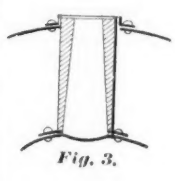


Fig. 3.

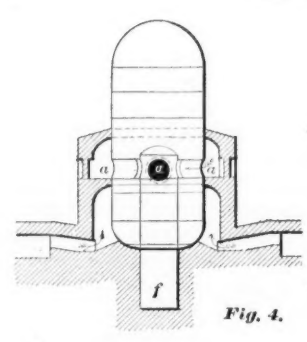


Fig. 4.

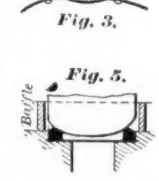
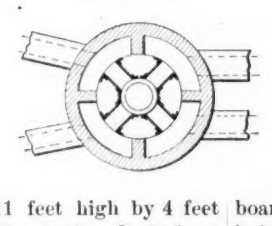


Fig. 5.



and a center tube 11 feet high by 4 feet diameter. It killed 25 people. It had no protection against the direct impingement of flames, had an unstrengthened manhole, and had been much repaired. Not only should baffle wads always be interposed in such cases, but the seating should be on special blocks, as in Fig. 5, with sloped backs, and seating edges not above three inches wide, so as to throw off any water that may run down the boiler and admit of full inspection.

W. H. BOOTH.

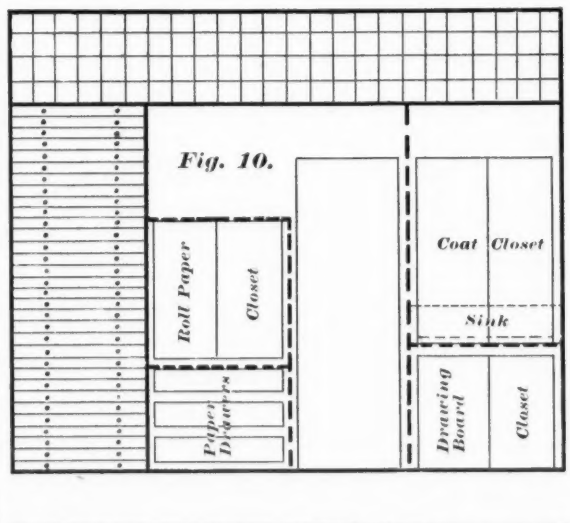


Fig. 10.

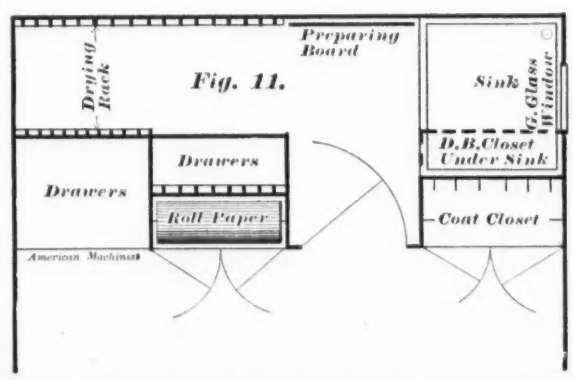


Fig. 11.

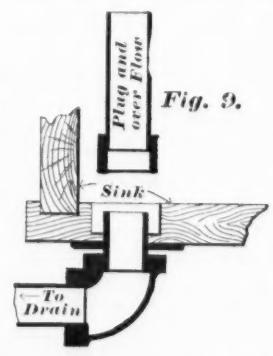


Fig. 9.

Suggestions About Drawing-rooms.

Editor American Machinist:

It is not my intention to tell how a drawing-room ought to be fitted up, but to offer some suggestions relative to it. The first thing to secure is good ventilation, for, without it, men soon become fatigued and dull. Plenty of light and room are also essential. While some may smile, it is nevertheless a fact that the southwest corner of a building is best adapted to the location of a drawing-room, that is, when there is plenty of light and space at this part of the building, for the reason that prints can then be made at almost any time of the day. The size of the room and the number of tables, of course, depends upon the number of men to be worked. Figs. 10 and 11 show elevation and plan for end of drawing-room about 12 foot wide, the scale being about one-quarter inch to the foot. As will be seen by examination of cuts, room has not only been economized, but we have a place for everything. Allowing that the drawing-room is 10 feet high, and as it is not necessary to make the print-room over 8 feet high, we have a space of two feet on top of it which can be utilized for pigeon-holes, as shown in cut, making them about 6″ square, to be used for pattern makers, drawings, etc. It is taken for granted that shop drawings are to be of three sizes, known as quarter, half and full size sheets, in which case each drawer would have two, three or four compartments. The number of drawers required is, of course, a matter of personal judgment, but it is good practice to run them up to the top, as shown in cut; the depth should be about 2″, and made of quarter-inch planed stock. Roll paper should be kept in a closet as shown, the drawers for the print paper being placed under the roll paper closet, as shown. These drawers should be about 6″ deep. The drawing board closet should extend under the sink far enough to take in the longest drawing board, boards to stand on their side. Coat closet is located right above it, and should be 15″ or 18″ deep. Back of the coat closet, and over the drawing board closet, is the sink; under this, and back of the D. B. closet, another closet can be made to keep the chemicals in. The sink is an important part of the work. Wooden sinks are best adapted to the business, and should be made of liberal size—three feet square, for instance. Fig. 9 shows design for a sink plug and overflow; it is made of common wrought-iron pipe and fittings; the plug and overflow is of such length that it will reach within an inch of the top of the sink; when it is desired to fill the sink the plug is screwed down on to the nipple. Being larger than the supply pipe, it prevents the sink from overflowing when the water is carelessly left running; between the flange and the sink a piece of packing should be used. Sink should be about 8″ deep, and three feet above the floor. The drying racks are notched pieces of board fastened to the partitions to receive bars of pine wood about ½″x1″ in size—pine wood is best adapted, for the reason that tacks will enter it easily. Preparing board is placed in front of door as shown. A ground glass window may be placed between shop and print room as shown. Heavy lines on drawing indicate partitions. Drafting-rooms should be sheathed up, not plastered, as it is often desired to tack up on the walls, drawings, tables, etc.; beside, with plastered rooms, the skaking of the building is liable to cause the plaster to crack and fall. Drawing tables should be from 35″ to 40″ high, and supplied with screw chairs. Main drawing table should be about 6′x8′, and rest on two common horses.

J. L. BIXBY, JR.

The Foreman.

Editor American Machinist:

The requirements necessary for a foreman machinist doubtless vary in different establishments, but as "like causes produce like effects" so it is in this instance. All foremen should have a certain amount of similarity. A foreman should be fairly educated, have a natural tact for getting out of tight places, and above all things he should be a gentleman. It is not so necessary that he be able to take hold of a lathe or other tool and bury himself with the amount of work he can do, but he should be able to recognize a good and proper amount of work when accomplished, and lead his men up to it without seeming to rush them.

I have noticed many times that men dislike the rusher, not so much because he is a rusher as for the way he comes at them; the result is that not quite as much work is done. Men are much like swine, in that they may be easily led, but you are likely to have your hands full when you attempt to drive. "Let us get those castings chipped up" will lay them down beside the planer in much less time than will, "Snag them castings."

Another thing which shows good breeding is to prefix "Mr." to the men's names when addressing them. It don't cost anything, and raises the men in their own estimation, and I will guarantee that they will respect you more for it.

Don't advertise the fact that you are a walking encyclopedia, because it is likely that there is a later edition; likewise a prophet in his own country don't stand half the show that a foreigner does. Have one rule regarding information, and let all, from the last apprentice to the office boy (who is a cousin of the treasurer) ask pertinent questions, and answer them to the best of your ability and time, and you will increase the respect of the men.

Don't lie to the men; you will certainly get caught at it, and it will undo everything.

A foreman should never allow nicknames to be used; it is vulgar; it is also demoralizing to whistle to a man as you would to a dog, or call him "Say" or "Here." I would not go quite so far as the captain did, during the "late unpleasantness," when he gave the order, "Gentlemen, you will please shoulder arms," but I know that where courtesy prevails there harmony has a home, and in a harmonious shop you may look for good work, and lots of it. Such a shop is no place for Mr. Marlin the grumbler, and he won't stay where he can't get a foothold. He will not wait to be told to go, but will go of his own will.

J. A. GILKERSON.

Standards—Mechanical Papers—Amateur Work—Catalogues and Clippings.

Editor American Machinist:

The question of "standards" has long been a theme for discussion, and will bear much more, particularly in regard to wire gauges. It seems as though they tried to make as ungainly sizes as possible, and with seemingly no motive for the deviation from the decimal system.

True, the sizes are given in decimals, but how much simpler and easier for everybody concerned to have the No. 10 wire .10 of an inch, and all others similarly classed. Or, if it is desired to go finer than hundredths, the wire could be called No. 100, and still have the same size; then the number would be the size of the wire in thousandths of an inch. No. 125 would be .125″, or what is called "⅛ wire" by many; by the gauge as used it would number 8, or nearly that. Rifle makers adopted that form of measuring many years ago, unless I have been misinformed; if they did not, they have the credit for it at any rate, and the example should be followed by all means.

The change would not cause great confusion, as would be the case if another of

the present systems were to be adopted, but the sizes would at once convey an idea of the wire spoken of, especially to those at all accustomed to machine work, and they are the ones who use it the most. As it is now, you can order wire by one gauge, drills by another, and sheet metal and piano wire by one still different; why not adopt the one that appeals to the senses as being reasonable and convenient, and save all this difference and chances for misunderstandings?

This question may be carried much farther, and have it apply to new designs as well as sizes of commercial articles. When designing a new line of articles of any kind whatever, why not adopt some standard sizes for all places possible? Why not have the shafts 1.60″ as well as 1.57″, or even 1.50″ if that is sufficient? But the even hundredths (or, more properly speaking, the .005″,) is generally as close as is needed, and it is much more uniform to have the shafts or other parts at some such point than to introduce an odd size. Make the first one right and the rest will follow, but if the first is "just what it trues up to," the next one is apt to be the same size, and a size once established is hard to depart from.

Those who have dealt with articles that were started on the all-right-for the-first-one plan, know how hard it is to get the sizes where they belong; there are always repairs to be considered, and every change makes so much more to keep track of, for if record is not kept, duplicates cannot be sent with any certainty of fitting. Often in sheer discouragement at the prospect of keeping a record of the innumerable changes necessary to establish uniformity, the foreman will decide to let them continue as of old, and every day delayed makes the task all the harder.

It is astonishing to find, at this time of the world's advancement, so many mechanics who do not read the mechanical papers. A trip through the different sections of the country will reveal some startling facts in this direction, though the papers are penetrating farther and farther each year. Many men in cities, as well as the out-of-the-way places neglect the opportunity that is offered by any first-class paper of becoming acquainted with the current thought and the latest developments of mechanics at a remarkably low figure, considering the value received. Not only are we brought in contact with the latest and best practices, but are afforded an opportunity not otherwise to be obtained, of becoming familiar with the latest types of machinery for all purposes.

It is a valuable educator to be shown the new machines as they are brought out, and the descriptions make their actions intelligible to all that read carefully and study the cuts that help so much to make a machine plain to the reader.

This lack of interest is not confined to the shop, but extends to the proprietors of the same. One would naturally think that it would be of almost vital interest to the owner or manager of an establishment to keep up with the times, and know what others are doing in the same line; it is easy to get behind the procession, but not so easy to catch up again. It is not necessary to say that the reading man, mechanic or otherwise, is the one that not only enjoys life, but keeps abreast the most advanced thought and practices in all directions.

Thinking of small engines and boilers, the subject of amateur work comes to mind. It is often held as being time wasted, but is it? Does it not give a better idea of the requirements in practice if the student works on something of the kind and gets a good idea of the construction? When it is possible to get practice with a full size machine, it is undoubtedly better, but all do not possess that opportunity, and all reading without any practice becomes tiresome and unsatisfactory.

The same may be said in regard to the study of electricity. The laws that govern it, and the facts brought out by practice, are much more readily understood and remembered if they can be shown in actual practice, and for this reason it does not seem foolish to the writer to spend the time in building either of the above, when it is impossible to otherwise obtain the practice in real service.

The peculiarities of the electro-magnet, and its seemingly strange actions at times, can be learned from the actual magnet in much less time and with little chance of a misunderstanding of terms employed. It is much more pleasant, and I believe more instructive, to have working models of the subject in hand, and by reference to them the language of the text-books becomes more clear and better understood.

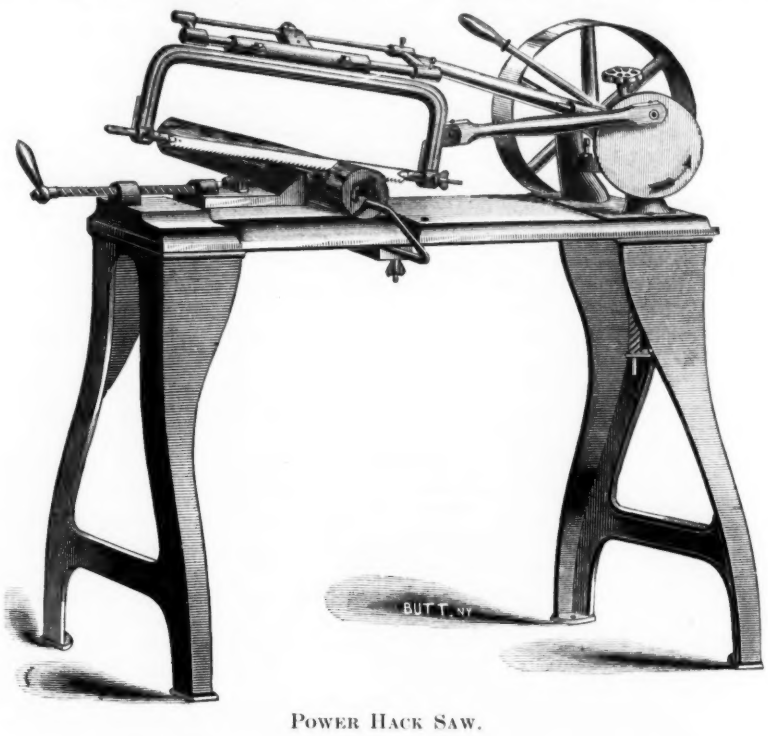
Having seen quite a number of letters in reference to keeping catalogues, it may be in order to speak on the subject of preserving "clippings" from papers. The AMERICAN MACHINIST I preserve intact, and have several volumes of it bound. It is not expensive, and is the best way to preserve them and keep them as references, but we cannot keep all the papers we see, and so must clip the portions that are of interest to us, or that will be of use at some future time. The "scrap-book" never took my fancy, and though I did start one, it never reached its normal growth.

At the shop I keep my clippings in large envelopes (about 8x12), and have each envelope for certain subjects. As far as possible I keep the subjects in separate places, so as to facilitate finding when wanted. When the subject is one that does not occur frequently, it has to be pocketed with some of the others, so as to keep the number of envelopes within reasonable bounds. It is sometimes impossible to keep the subjects separate, as they often appear so as to be inseparable except by cutting into both, in which case they must be put in the most appropriate envelope. By marking the subjects contained in each envelope on the inside of the flap, and laying them away so as to be readily opened to show the subjects, clippings can be taken out with very little trouble.

For home use I have some of these regular "letter files," these multi-pocketed envelopes that are built on the same plan as the accordion skirt. By pasting the labels in a conspicuous place on each pocket, you can have as many subdivisions as you like. Then, when you want to find anything about gears, dynamos, boilers, transformers, or whatever subject you are interested in, you have them at command with very little trouble. The scrap-book may have advantages, but the time saved in putting the clippings into pockets, instead of pasting them into scrap-books, must be tried, to be appreciated.

It is very convenient sometimes to know the date at which a certain article appeared, and it is little trouble at the time to just write the date somewhere on the margin; it is a good plan, and often saves much controversy. Another advantage over the scrap-book is in case the desired article covers both sides of the sheet, in which case it is much to be preferred. Besides printed articles, I find it convenient as well as instructive to preserve some of the different cuts of new machines, arc lamps, new engines, plans for rapid transit, and in fact anything that seems to be novel and worthy of serious consideration. The letter files do not cost much, and take up little room, and taken as a whole they form the best means of preserving clippings that I know of. They need not cost over 25 cents each, and they will hold an astonishing amount.

FRED H. COLVIN.



POWER HACK SAW.

Power Hack Saw.

A number of these machines have been in successful operation during the last six months. They are well adapted in shops where there is not enough cutting to do for the more expensive circular saw. As will be seen in the illustration, the saw is made to run with a belt. It runs at a speed of 40 strokes per minute, and does its work without attention. One blade will cut off a steel shaft five inches in diameter several times, and it is said that it will do ten times as much work as is usually done by hand, as the speed and pressure are regulated and uniform. The machine is manufactured by Millers Falls Co., 93 Reade street, New York.

Hand-power Beveling Shear.

On this page we give an illustration of a new beveling shear brought out by the New Doty Manufacturing Company, of Janesville, Wis.

The shearing blades are so arranged that they will give the proper bevel to the edge of a boiler sheet, and, circular shears being provided for the machine, throat sheets, dome flanges, etc., can be readily beveled. With this machine a sheet can be cut to almost any desired shape, being provided with shears for trimming either flat or bent sheets.

A pinion enclosed within the frame of the machine moves the shearing lever, which is also enclosed within the frame, and supported on both sides.

HAND-POWER BEVELING SHEAR.

An Englishman, Mr. F. K. Parkinson, has been making a tour of this country, and he appears to be a close observer. He is quoted by the *Boston Traveler* as speaking as follows, regarding manufacturing in New England:

The thing that struck me as particularly peculiar about your country, is the fact that your manufactories are here in New England, or largely so, while the stuff you manufacture is most of it away off in the South. Of course I understand why this is, from the talks I have had with your manufacturers, but it seems to me that this very fact opens a great chance for investment in manufactures in other sections. Now take, for instance, your cotton industry. Through a visit to Lowell, and talks with mill men there and here, I find that the conditions which existed when those mills were built are almost entirely changed. The mills were built there, as I understand it, on account of the great water power, but a mill agent told me that to-day there is actually not one element which enters into the manufacture of cotton cloth which is produced in this State. Steam power has taken the place of water, and even the labor is most of it imported from Canada. The cotton, he tells me, comes from the South, and the iron and coal from Pennsylvania.

The State railroad commissioners have adopted a rule that conductors, when running on modified orders, shall give flagmen their instructions in writing instead of orally. If the conductors can at all times, and at the drop of a hat, unambiguously write these orders in the English tongue, it is more than any railroad president, director or commission in this broad, fertile and glorious land can do—for money.—*Evening Sun.*

On railroads in India the use of steel ties near the sea has been discontinued, on account of their rapid corrosion.

AMERICAN MACHINIST

Communications relating to the reading columns should be addressed to the Editor. All other communications should be addressed:

AMERICAN MACHINIST,
96 FULTON ST., NEW YORK.

PUBLISHED WEEKLY AT
96 Fulton Street, New York.

HORACE B. MILLER, Pres't and Bus. Manager.
LYCURGUS B. MOORE, Treas. and Sec'y.

F. F. HEMENWAY, Editor and Mech. Engineer.
J. G. A. MEYER, } Associates.
FRED J. MILLER, }

Special Announcements.

☞ *Positively we will neither publish anything in our reading columns for pay or in consideration of advertising patronage. Those who wish to recommend their wares to our readers can do so as fully as they choose in our advertising columns, but our editorial opinions are not for sale. We give no premiums to secure either subscribers or advertisers.*

☞ *Every correspondent, in order to insure attention, should give his full name and address, not for publication, but as a guarantee of good faith.*

☞ *We are not engaged in procuring patent rights, or in selling machinery, nor have we any pet scheme to advance, or hobby to ride.*

☞ *We invite correspondence from practical machinists, engineers, inventors, draftsmen, and all those specially interested in the occupations we represent, on subjects pertaining to machinery.*

☞ *Subscribers can have the mailing address of their paper changed as often as they desire. Send both old and new addresses. Those who fail to receive their papers promptly will please notify us at once. Date on wrapper denotes week with which subscription expires.*

Subscription.

$3.00 a year in advance, postage prepaid, in the United States, Canada, and Mexico.
$4.00 a year to Other Countries, postage prepaid.

Advertising.

Transient, 35c. per line, each insertion.
"Business Specials," 50c. a line.

The American News Company,
Publishers' Agents, New York.
The International News Company,
BREAM'S BLDG'S, Chancery Lane, LONDON, E. C., ENG., will receive subscriptions for the AMERICAN MACHINIST, at 16/6 per annum, postage paid.

DEALERS SUPPLIED BY

The Albany News Company, Albany, N. Y.
The American News Company, New York, N. Y.
The Baltimore News Company, Baltimore, Md.
The Brooklyn News Company, Brooklyn, N. Y.
The Buffalo News Co., Buffalo, N. Y.
The Central News Company, Philadelphia, Pa.
The Cincinnati News Company, Cincinnati, Ohio.
The Cleveland News Company, Cleveland, Ohio.
The Colorado News Company, Denver, Colorado.
The Detroit News Company, Detroit, Mich.
The International News Company, New York, N. Y.
The Minnesota News Company, St. Paul, Minn.
The Montreal News Company, Montreal, Canada.
The National News Company, New York, N. Y.
The Newark News Company, Newark, N. J.
The New England News Company, Boston, Mass.
The New Orleans News Company, New Orleans, La.
The New York News Company, New York, N. Y.
The Northern News Company, Troy, N. Y.
The Omaha News Company, Omaha, Neb.
The Pittsburgh News Company, Pittsburgh, Pa.
The Rhode Island News Company, Providence, R. I.
The San Francisco News Co., San Francisco, Cal.
The South West News Company, Kansas City, Mo.
The St. Louis News Company, St. Louis, Mo.
The Toronto News Co., Toronto, Ontario, Canada.
The Union News Company, New York, N. Y.
The Washington News Company, Washington, D. C.
The Western News Company, Chicago, Ill.
The Williamsburgh News Co., Brooklyn, E. D., N. Y.

Subscriptions received in Australia by W. WILLIAMS, 17 and 21 Fink's Buildings, Melbourne,

NEW YORK, JULY 9, 1891.

CONTENTS.

PAGE.

Double-cylinder Hoisting Engine.. 1
The Use of the Slide Rule. By Coleman Sellers. 1, 2
Boiler Makers' Drill Press..... 3
Pittsburgh Shop Notes. By F. J. M..... 3, 4, 5
A New Belt-testing Machine. By Geo. I. Alden, Worcester, Mass..... 5
Letters from Practical Men: Large Upright Boilers. By W. H. Booth....Suggestions About Drawing-rooms. By J. L. Bixby, Jr .. The Foreman. By J. A. Gilkerson....Standards—Mechanical Papers—Amateur Work—Catalogues and Clippings. By Fred. H. Colvin 6, 7
Power Hack Saw..... 7
Hand-power Beveling Shear..... 7
The Wages Question..... 8
Literary Notes..... 8
Questions and Answers..... 8, 9
Manufactures..... 9, 10
Test of a Triple-expansion Engine..... 10, 11
Machinists' Supplies and Iron..... 11, 12

The Wage Question.

The amount of discussion brought out at the Providence meeting by Mr. Halsey's paper on the premium plan of paying wages is, we think, significant of the interest taken in the whole question of wages. Ambition is in a certain sense only another name for dissatisfaction. A man does not have ambition to rise to a higher position unless he is in a certain sense dissatisfied with his present one. Ambition and ambitious men are necessary, and it is not to be expected that men will be ambitious only in the particular directions that others desire to have them ambitious. If they have spirit enough to be ambitious with regard to anything they will be ambitious for the things which seem most desirable to them, and as wages represent all that the average workingman gets in return for his life work, it is to be expected that he will want his wages to be as high as possible. High wages mean a higher plane of living for himself and his family, while lower wages mean the opposite, and if a man may not properly be ambitious to give every possible opportunity for comfort and enjoyment to his family, what may he be ambitious for?

Fortunately, it so happens that the interests of employers and of workmen, considered as such, lie in the same direction, *i. e.*, in the direction of high wages. It has been demonstrated over and over again that high-priced labor is the cheapest labor, and that, cost per yard or per pound considered, the cheapest goods in the world are made by the highest paid labor. But as between individual employers competing in the same market, and employing labor under the same conditions, the advantage of paying higher wages than others is not so clear, and is certainly not commercially possible unless more efficient service is thereby secured. It thus comes about that the interests of manufacturers in any country, taken as a body, are somewhat at variance with those of any individual manufacturer in that country, because the general manufacturing prosperity depends largely upon high-priced labor, while the individual employer is interested in getting the best and most efficient labor at the lowest possible price.

Any honest effort to show a means by which these conflicting interests can be reconciled should be welcomed by all parties concerned. By such efforts, and candid, fair-minded discussion of them, the way to a solution of the difficulty will finally be found, and, until it is found, there will inevitably be more or less agitation of the subject.

And it is to be noted that the study and discussion of systems, with a view to their improvement, is far better than mere criticism of individuals. We have faith enough in human nature to believe that most men will prefer to do nearly the right thing, if they have a fair opportunity of doing so, and, given favorable conditions for right actions, those who are not naturally disposed to do right will soon be compelled to do so by purely commercial considerations, assisted by the force of public opinion.

Above all things it is important that both employer and employe should be ready to "hear the other side," and to listen to the voice of reason. It should be perfectly recognized that the desire for high wages is a proper one, and on the other hand it should be recognized that no manufacturer who is not at the same time a monopolist can continue long in business, if his goods cost him materially more than they cost others who are in competition with him, and both sides should at all times be willing to hear and consider the views of the other. To attempt to discourage all discussion of the subject is useless, for this question is in one respect like that of slavery, which Lincoln declared would never be settled until it was settled right.

Mr. Halsey's plan seems to us to have points of superiority over other systems. It is not an illy considered thing, but has been in the mind of the author for a long time, and to some extent has been tried with very satisfactory results. We hope that others will see their way clear to give it a trial, and to improve upon it where it seems capable of improvement.

The Springfield *Republican*, of recent date, seriously discusses the possibilities of a new cycle, which the inventor claims will be able to outrun the fastest express trains, and, in fact, that it will be easily able to go at the rate of 120 miles per hour over ordinary roads. It will have but one wheel, and the inventor seems to think that one of the most serious difficulties in connection with the machine will be to control its terrific speed, since it will require "from seven to ten times less power than the ordinary bicycle." If it will be any comfort to the enthusiastic inventor, or to those who may think that ordinary travel on the high-roads is to be made impossible by this new machine, we may say that there is no danger. The air resistance encountered at that speed, to say nothing of frictional or other resistances, will require at least 100 horse power to overcome it. We are reminded by this of the inventor of a perpetual motion machine, who, believing he had solved the problem, rushed into a model-making establishment to have a model made. He insisted upon having the brake made first, so that the machine could be stopped, for he declared that if his machine once got going, it would destroy itself by its speed unless some means were at hand to check it.

The wild exaggeration of the circus poster is closely approached in many instances by the country newspaper which undertakes, to chronicle the doings of the manufactories of the place where it is published. Even the most ordinary new machine brought out is sufficient in many instances to cause the local paper to go into violent hysterics, and to perpetrate some of the most astounding things in the way of headlines. The bringing out of a very ordinary machine may lead to headlines declaring in the largest type that "Slumptown's Tidal Wave of Leadership in Manufacture Continues to Sweep the Country." "Nothing Approaching This Has Ever Before Been Produced." Of course experienced persons know that by the time a town gets to be really an important one in manufactures, its papers have usually learned not to indulge in this sort of stuff, and, like the circus poster, it is heavily discounted. Then, to make the case still more aggravating, when we look under the shrieking headlines for some information about the machine, we find a lot of garbled stuff, which simply tells nothing at all. Newspapers published in manufacturing towns would show much better appreciation of the requirements of their situation if they would devote less attention to absurd headlines, and more to accurate and intelligible description of new machines brought out in their locality.

Mr. J. H. Decker has resigned his position as secretary, treasurer and superintendent of the Salina Water-works Co. and the Winfield Water Co., and accepted a position with Henry R. Worthington, in charge of the department of supervision and maintenance of all water-works and other large pumping works erected by that firm.

There must be some very queer machinery aboard the new French steamer "La Touraine," according to a newspaper account, which says that one of the firemen of the vessel, while cleaning the machinery, "was struck by the cylinder and instantly killed."

Literary Notes.

BOILER TESTS. Embracing the Results of One Hundred and Thirty-seven Evaporative Tests, made on Seventy-one Boilers, conducted by the Author. By Geo. H. Barrus, S. B., Member of American Society of Mechanical Engineers and Boston Society of Civil Engineers. Boston: Published by the Author. Selling Agents, Gowing & Co., 70 Kilby street, Boston, Mass.

It appears to us that the author has given to engineers, manufacturers and others interested in making and using steam, just what they want in this book. There has been lack of concise information, in convenient form, on the performance of boilers under different circumstances and conditions, and this the author supplies by giving the results of a large number of tests of different boilers, illustrations helping to convey a knowledge of construction, setting, etc.

The manner of conducting the tests—the greater part of which were made with the boilers in actual service—is quite fully explained.

Interesting facts are given relating to the wasteful effects of high flue temperature, improper proportion of grate and heating surface, number of tubes, etc.

As is quite generally known, a good deal of the author's practice during the past ten years has been in the line of testing steam plants, hence he has no occasion to go outside his own work to find material for what we consider a very interesting and instructive book.

The price of the book is $5.

TINSMITHS' AND SHEET METAL WORKERS' POCKET REFERENCE BOOK. Compiled by C. E. Bodley.

This little paper-covered book of 63 pages contains a well-arranged and comprehensive collection of practical information for tinners and sheet metal workers. The numerous tables, rules, receipts, and other valuable information cannot fail to be of great aid to those for whom the book has been compiled. It is published by Daniel Stern, American Artisan Press, Chicago, Ill. Price not given.

We have received from the *Marine Record*, Cleveland, Ohio, the edition of 1891, of *Beeson's Sailors' Hand Book and Inland Marine Guide*. It gives a complete list of American steam and sailing vessels on the Northwestern lakes, name, rig, tonnage, when and where built, and the address of the managing owner. In addition to this it contains articles on shipbuilding, tonnage, depth of water in harbors, pilot rules, and on many other subjects of interest. The book can be had from the office of the *Marine Record*. Price one dollar.

Questions and Answers.

Questions of general interest relating to subjects discussed in our columns will receive attention in this department. The writer's name and address should always accompany the question. Neither correct initials nor location will be published when there is a request to that effect. If questions are enclosed with a business communication, they should be written on a separate sheet.

(299) B. B. B., New York, writes: Kindly inform me through your columns by what process sun prints are made; for instance, the so-called crayon portraits, which are sold so very cheap. By giving me the above information you will greatly oblige, and also decide a difference of opinion. *A.*—The sun prints are taken on paper specially prepared for the purpose from ordinary negatives. For the details of the process we must refer you to books treating on photography. In such books you will doubtless find all the information you may require on the subject, so far as such information can be given in print.

(300) R. G. M., San Francisco, Cal., writes: Kindly inform me through your columns, if there is any place in the United States where I can get drawings of machinery at a reasonable price. There are two or three places where I can get architectural designs, and I have heard there was a place where I could get the working drawings of most any machine. *A.*—We are not aware that working drawings of nearly all machines have been published. We have seen sets of working drawings of marine engines published separately, but not of other machines. There are books which treat on some special branch of machinery which often contain working drawings of that class only. We know of no other way for obtaining drawings of different classes of machines, than by making a good selection of books.

(301) W. T. K., Salem, Ohio, asks: Can a steam engine be built to run economically and cut off at about one-half stroke, the cut-off to be fixed, and wire-draw the steam to effect regulation? *A.*—There are many engines of this class built; they are more suitable for small powers, and work satisfactorily, provided the variation of the load is not too great. 2. Would an engine of this kind, if well built, class with good modern

engines? *A.*—In many cases it will not give as good results as a good automatic engine. 3. Are there engines built on this principle other than with ball governor regulations? *A.*—No; all have a ball governor or its equivalent. 4. At what point of cut-off will an engine develop its maximum power? *A.*—An engine will develop its maximum power when steam follows very nearly full stroke, but under these conditions much steam will be wasted. Many engineers consider the most economical point of cut-off for simple engines to be at ¼ of the stroke; others prefer to cut off a little later.

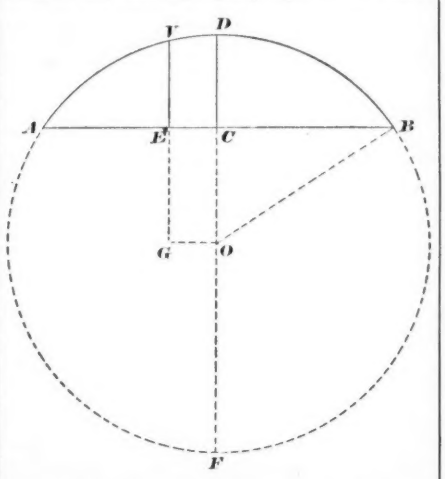
(302) L. D. C., Tacoma, Washington, writes: Please inform me through your columns, if there will be any economy in the following arrangement, and how much. I have three pumps of equal capacity; No. 1 is driven by a belt from a 10x16-inch engine. Nos. 2 and 3 are common simple duplex steam pumps with steam cylinders 20 inches diameter, making a total of four cylinders 20 inches diameter. By speeding the engine on No. 1 properly, can I run the exhaust from it into the other two pumps (in other words compounding) to any advantage? The engine on No. 1 pump runs with an average pressure in the cylinder of 40 pounds, and the steam pumps also run with an average pressure of 40 pounds, or a little less. I can carry 100 pounds boiler pressure easily. I would not care, if, after compounding, No. 1 pump would not have equal capacity. *A.*—We cannot advise you; we have not sufficient data. If the engine is properly constructed for the work she has to do, there will not be any advantage gained by compounding, as you propose to do, as the combined cylinder capacities of the duplex pumps are too great for the capacity of the cylinder on the engine; in fact, there may be a great disadvantage, in case it is necessary to run only one or two pumps at a time, instead of the three.

(303) Reader, Canton, Ohio, writes: Please give me your opinion on the following matters: We carry a pressure of 65 pounds of steam in our boilers; and our 100 H. P. automatic cut-off engine is doing work of about 65 H. P. We use steam for another purpose besides running the engine with a steam pressure of 65 pounds. Now it takes about ⅛ of all the steam we can make for this extra purpose, and we have to fire very hard and use the best of coal. Suppose we carry 85 pounds of steam for the engine and put on a pressure regulator to reduce the steam to 65 pounds for the extra purpose. Do you think the steam will be dryer after leaving the regulator than it is now? *A.*—No. 2. Will the boilers make steam any easier than now? *A.*—By using a higher steam pressure for the engine, developing the same power as before, you will save fuel, and consequently if at present you have a sufficient quantity of steam for the extra purpose, you will, of course, not need the fuel saved by running the engine with a higher steam pressure, and on this account it may be said that the boiler will steam easier. 3. Will the steam be cut off too early in engine for the best results after making this change? *A.*—No; if the engine is not to develop any greater power, you will have to cut off earlier than at present.

(304) F. A. F., Watertown, N.Y., writes: I would like to know the main characteristics of aluminum? What is its hardness compared with other metals and alloys in common use in a machine shop, as brass, copper, tin, etc.? *A.*—See our issue of February 5, page 3, current volume. 2. What is its melting point? *A.*—1,300 degrees Fahr. 3. Will it flow into delicate figures on the face of a plaster of paris mold. *A.*—We believe it will. 4. Is it soft when cast? Does it require to be rolled to become hard? And can it be tempered? *A.*—It is comparatively soft when cast; it will become stronger by rolling; and it cannot be tempered. 5. Can it be used for cutting tools, as knives, etc.? *A.*—No. 6. I have seen an alloy of copper and aluminum which resembled gold and was said to be untarnishable as gold. Can you tell me what the proportions for mixture are? Is it what is called aluminum bronze? *A.*—It is difficult to find out the exact proportions of these mixtures for ornamental purposes, as manufacturers do not care to say much about it. Aluminum bronze is composed of nine parts of copper and one part aluminum. This will tarnish quite readily, but not more so than copper. 7. Is there anything better than plaster of paris for mold of small objects which are to be cast very smooth and accurate? *A.*—We do not know of anything better.

(305) C. E. M. W., ——, Ill., writes: I would like to know what kind of an institution the schools in Cooper Union in New York are. I want to enter some college where I can work my way up in mechanical engineering; am not yet 21; have had a good common school education, and have worked in machine shops six years. Please give me the address of the Cooper Institute. *A.*—Send your application to the office of the Cooper Union, New York City. Applications should not be made before June 15th. The night schools of the Cooper Union are organized in two sections, called respectively the scientific department and the art school. The term of the scientific department commences on the 1st of October, and ends on the 15th of April. The regular course of study in this department requires five terms for its completion, and to those who have successfully completed it the Cooper medal and diploma are awarded. The following is the regular course of study: First year: Algebra, geometry, natural philosophy, and elementary chemistry. Second year: Algebra, geometry, elementary chemistry, and astronomy. Third year: Trigonometry, descriptive geometry, analytical geometry, mechanics, geology (from October to January), electrical measurements (from January to April). Fourth year: Analytical geometry, differential and integral calculus, and mechanical drawing. Fifth year: Applied mechanics. Each applicant for admission must be at least 15 years of age. Residence in New York City is not a necessary condition of admission. A letter of recommendation from his employer is regarded as desirable. Any pupil absent three times without a satisfactory excuse forfeits his position in the school.

(306) J. D., New York, writes: Please inform me how to find the distance from *V* to *E* in the accompanying figure. I know



there is some way of finding it, as a man in our shop has done it, but he will not show me how to do it. In this figure the chord *A B* is 5 feet, and the height *C D* of the arc, which is part of a circle, is 3¼ inches, and the distance from *C* to *E* is 7½ inches. *A.*—The first thing to do is to compute the radius of the arc, for which we have the following rule: Square *A C*, that is, one-half the chord, and divide this product by the height *D C*, all in inches; the quotient will be the length of *C F;* add to this the height *D C;* the sum will be the diameter; one-half of this will be the radius *O B*. According to this rule we have,

$$\frac{30 \times 30}{3.25} = 276.923 \text{ inches},$$

which is the length of *C F;* and 276.923 + 3.25 = 280.173 inches for the diameter; and $\frac{280.173}{2} = 140.086$ inches for the radius. To find *E V*, square the radius *O B*, and from this product subtract the square of *E C;* find the square root of the remainder; the result will be the distance from *V G;* from this subtract *E G;* the remainder will be the height of the ordinate *E V*. Thus, the square of the radius *O B* is 140.086 × 140.086 = 19,624.087+. The distance *E C* is given, 7½ inches; the square of this is 7.5 × 7.5 = 56.25; and 19,624.087 — 56.25 = 19,567.83; the square root of this is $\sqrt{19,567.83}$ = 139.88. We know the radius is 140.086, and *C D* is 3.25, hence *E G* will be 140.086 — 3.25 = 136.836; therefore *V E* = 139.88 — 136.836 = 3.044 inches.

(307) C. S., Hoboken, N. J., writes: Kindly inform me how to compute the amount of molten metal a ladle will contain; and also how to compute the weight of the plate; and if there is a book published pertaining to foundry use. The size of one ladle of which I wish to compute the contents is 2 feet 6 inches inside diameter, and 4 feet 6 inches deep; the other ladle is 2 feet 6 inches diameter at top, 2 feet diameter at the bottom, and 3 feet 6 inches deep. The size of the plate of which I wish to obtain the weight is 8 feet long, 4 feet wide and 2 inches thick. *A.*—The contents of the first ladle are found by multiplying its cross-sectional area by the depth, either all in feet or in inches, the result will be cubic feet or cubic inches. Thus the area of a circle 2 feet 6 inches diameter is 4.9 square feet, and 4.9 × 4.5 = 22.05 cubic feet. To compute the contents of the second ladle: Add together the areas of the top and bottom, and the area of the mean proportional, and multiply the sum by one-third of the depth. For the area of the mean proportional (which is not the area half way between top and bottom and parallel with these), multiply together the areas of top and bottom, and take the square root of the product. The area of the top of ladle 2 feet 6 inches diameter is 4.9 square feet; that of the bottom 2 feet diameter is 3.14 square feet; the area of their mean proportional is $\sqrt{4.9 \times 3.14} = 3.92$; adding these areas we have 4.9 + 3.14 + 3.92 = 11.96. One-third of the depth $\frac{3.5}{3} = 1.16$; hence 11.96 × 1.16 = 13.8736 cubic feet. The weight of the plate is found by multiplying its length by the breadth and its thickness, and then multiply this product by the weight of the metal, thus: 96 × 48 × 2 = 9,216 cubic inches. The weight of a cubic inch of cast-iron may be taken at .26 of a pound, therefore the weight of the plate will be 9,216 × .26 = 2,396.16 pounds. American Foundry Practice, by Thomas W. West, is a good book to have.

(308) B. F. W., ——, writes: I desire to know some simple way of determining the diameters of cylinders for a triple-expansion engine. I do not understand algebra, and have to struggle with arithmetic. Suppose the high-pressure cylinder is 10 inches diameter, stroke of all the cylinders is to be 20 inches; steam pressure, 100 pounds. What should be the diameters of the intermediate and low-pressure cylinders? *A.*—There are several rules for computing the diameters of cylinders for a triple-expansion engine, giving results differing somewhat from each other. Indeed, the chief point at issue between rival engineering establishments, as well as between engineers generally, is as to what is the best ratio of cylinder capacity. The following rule gives generally good proportions: When the steam pressure employed exceeds 125 pounds absolute, the ratio of the low-pressure to high-pressure cylinder should be 5; for 135 pounds pressure absolute, 5.4; for 145 pounds absolute, 5.8; for 155 pounds absolute, 6.2; and for 165 pounds absolute, 6.6. The ratio of the low-pressure cylinder to the intermediate cylinder should be about one-half of that between low-pressure and high-pressure cylinders, as given above. By absolute pressure is meant the pressure as indicated by the steam pressure plus the atmospheric pressure, which is equal to 14.7 pounds; but for simplicity it is often taken at 15 pounds. Hence the absolute pressure for your engine will be 100 + 15 = 115 pounds. Now adopting the same ratio as given for 125 pounds pressure, then the area of the low-pressure cylinder should be five times the area of the high-pressure cylinder; the area of this cylinder (10 inches diameter) is 78.54 square inches, and 78.54 × 5 = 392.7 square inches, which is the area of the low-pressure cylinder, and the corresponding diameter is 22⅜ inches nearly. The area of the intermediate cylinder should be 2½ times that of the high-pressure cylinder; hence we have 78.54 × 2.5 = 196.35 square inches for the area of the intermediate cylinder; the corresponding diameter is 15⅝ inches nearly. Another rule, somewhat simpler than the above, is as follows: Multiply the diameter of the high-pressure cylinder by 1.5; the product will be the diameter of the intermediate cylinder; multiply the diameter of the high-pressure cylinder by 2.5; the product will be the diameter of the low-pressure cylinder. According to this rule we have 10 × 1.5 = 15 inches for the diameter of the intermediate cylinder; and 10 × 2.5 = 25 inches for the diameter of the low-pressure cylinder. It may be remarked here that since the low-pressure cylinder is the measure of the power of a compound or triple expansion engine, the general practice is to find first the size of the low-pressure cylinder; and from that the diameters of the other cylinders, instead of first determining the diameter of the high-pressure cylinder, as you seem to do. The above rules have been taken from "Manual of Marine Engineering," by A. E. Seaton.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

George B. Grant—Gear Wheels. See p. 20.

Link-Belting and Sprocket Wheels.
Send for Catalogue of Link-Belting.
Over 50,000,000 feet of Link-Belt in use.
Link-Belt Engineering Co., Philadelphia and N. Y.

Shafting Straighteners. J. H. Wells, Tampa, Fla.

N. Y. City Bolt & Nut Co., Limited.
"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y.

The Improved Justice Hammer. Williams, White & Co., Moline, Ill., manufacturers.

Pattern and Brand Letters. A variety of sizes and styles. Heber Wells, 8 Spruce St., New York.

Davis Key-Seating Machines kept in stock by Manning, Maxwell & Moore, 111 Liberty St., N. Y.

Ice and Refrigerating Machines, 170 sold, and all successful. David Boyle, 521 Monroe St., Chicago, Ill.

"How to Keep Boilers Clean." A 96-page book mailed free by Jas. E. Hotchkiss, 112 Liberty St., N. Y.

Selden Packing for stuffing-box, with or without rubber core. Randolph Brandt, 38 Cortlandt St., N.Y

Light Special Machinery and Tools to order. The Meriden Machine Tool Co., Meriden, Conn.

Universal Vise Chucks. Pedrick & Ayer, Philadelphia, Pa.

Link Planer Attachments. Pedrick & Ayer, Philadelphia, Pa.

$13.00 I. Dea L. Drawing Stands. The original. Send for postal. W. S. Rogers, Troy, N. Y.

Miller's Falls Co., 98 Reade St., New York, are building a Power Frame for their Star Hack Saw.

S. A. Smith, 23 So. Canal St., Chicago, Ill., agent for Appleton Mfg. Co.'s Emery Grinding Machinery.

For the Latest Improved Diamond Prospecting Drill, address the M. C. Bullock Mfg. Co., 138 Jackson St., Chicago, Ill.

Send $1 for Catalogue D, Fine Tools and Supplies. Over 550 pages. Fully illust'd. Free when $10 worth goods are ordered. Frasse & Co., 92 Park Row, N. Y.

"Twenty Years With the Indicator," by Thomas Pray, Jr. 10,100 sold. Price, $2.50. Order of bookseller; take no other.

Audubon Machine Works, New Haven, Conn. Electrical work, superior facilities. Builders of machinery, heavy and light.

Guild & Garrison, Brooklyn, N. Y., manufacture steam pumps, vacuum pumps, vacuum apparatus, air pumps, acid blowers, filter press pumps, etc.

Split Pulleys at low prices, and of same strength and appearance as Whole Pulleys. Yocum & Son's Shafting Works, Drinker St., Philadelphia, Pa.

S. W. Card & Co., Mansfield, Mass., make everything in the line of Taps and Dies. S. A. Smith, 23 S. Canal St., Chicago, Western Agent.

Most sensitive and durable Damper Regulator made; works within one pound. Send for circular. T. Kieley, 11 W. Thirteenth St., New York.

For the latest improved Eccentric Hook, Connecting Rods and Stub Ends, address T. C. Dill Machine Company, Philadelphia, Pa.

Self-adjusting Hand-Screw for Pattern and Cabinet Makers, Wood Workers, etc. Sample by mail for 50 cents. Wm. H. Denney, Lancaster, Pa.

N. Y. City Bolt & Nut Co., Limited, 33 and 35 Desbrosses St., N. Y. City, manufacturers of Machine Bolts of every description. Write for estimates.

Upright Drills and Iron Planers, for immediate delivery; prices reasonable. J. E. Snyder, Worcester, Mass.

Hydraulic Press, Steam Tables, Accumulator, Cutting and Stamping Dies, etc. S. Hartley, 245 N. J. R. R. Avenue, Newark, N. J.

25" } "Only Drill Press built on
32" } 'Ko-rekt' principles,
37" } even if they come from Jersey."
42" } Gould & Eberhardt, New Ark, N. J.

DuBois & DuBois, Patent Attys., 715 11th St., Washington, D. C., procure first-class patents. Send stamp for illustrated pamphlet, "March of Invention," containing valuable information, and list of references.

Hawkins' Hand-Book of Calculations. $2.50 postpaid. "The book is all that could be desired."—Jos. St. Clair, Richmond, Va. Theo. Audel & Co., Pubs., 91 Liberty Street, N. Y. Catalogue.

Every draftsman needs one. The Engineer's Sketch Book of mechanical movements, appliances, devices, contrivances, etc., by T. W. Barber. 1,936 illustrations, 8vo., cloth, $3. Catalogue of books on mech. subjects free. E. & F. N. Spon, 12 Cortlandt St., New York.

Our large Catalogue of Scientific and Practical Books mailed free to any address. It embraces works on more than fifty different subjects; is subdivided, enabling to refer to a particular subject. Norman W. Henley & Co., 150 Nassau St., New York.

De Lamater Screw Propeller Wheel, made only by The Samuel L. Moore & Sons Co., Elizabethport, N. J., who have purchased from C. H. De Lamater & Co., New York, all their patterns, books of record, gauges, etc. Location and equipment well adapted for Heavy Steamship Repairs.

Club Rates.—If no one is getting up a club for the AMERICAN MACHINIST in your town or establishment, send for Circular of New Club Rates, and try it yourself. Address AMERICAN MACHINIST, 96 Fulton St., New York.

"Binders" for the AMERICAN MACHINIST. Two styles—the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers with full page opening flat. Either will hold the entire 52 issues of any volume. American Machinist Publishing Co., 96 Fulton St., New York.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator and making all required calculations from the diagram, also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price, $2, postpaid. Published by John Wiley & Sons, 53 East Tenth Street, New York.

MANUFACTURES

An effort is being made to establish a steel plan in Allentown, Tenn.

New machinery is to be added to Flynn's roller mill, at Iowa Park, Tex.

A shovel and spade factory is reported as to b established at Harrisburg, Va.

The Gem Furnace Company, Leesburg, Va., is reported as building a rolling-mill.

The Weston Engine Company will locate a Painted Post, near Corning, N. Y.

The Eufaula (Ala.) Cotton-mills will probably increase its capital stock to $200,000.

It is reported that the Union Pacific will build extensive repair shops at Ogden, Utah.

The Camden Anchor Works, at Camden, Me., are to have a new building 150x80 feet.

Wallace, Banfield & Co. are to add a new cold-rolling-mill to their plant at Irondale, Pa.

The Talledega (Ala.) Ice Company is reported as to increase the capacity of its ice factory.

The Marshalville (Ga.) Manufacturing Company will erect iron foundry and machine shops.

The Brush Electric Company, Cleveland, Ohio are to put in a 200-pound Hackney hammer.

The Fagan Iron Works, Hoboken, N. J., have been incorporated, with a capital of $100,000

R. J. Saywell has, it is reported, started an iron foundry and machine shops at Anniston, Ala.

An addition is to be built to the plant of the Hoskins & Hinnerth Foundry Co., at Highgate, Vt.

A new company is now being formed at Troy, N. Y., for the manufacture of burnishing machines.

The United States Tin Plate Company, of Philadelphia, Pa., is to increase its capital to $500,000.

The Middlesex Knitting-mills, Martinsburg, W. Va., will add 150 knitting machines to their plant.

Lucadoe & Hager will, it is reported, put new machinery in their iron foundry at Glen Elk, W. Va.

A company has been organized to build an iron foundry on the Rancocas Creek, near Mount Holly, N. J.

A. H. Osburn, Clarksburg, Va., will rebuild at once his iron foundry and machine shops recently burned.

The Hutchins Machine Company is the name of a new concern at Worcester, Mass. It is capitalized at $25,000.

The National Supply Company has been organized at Chicago, Ill., to manufacture boilers, engines, etc.

The establishment of an ice factory is contemplated at Jackson, Ga. R. W. Mays can give information.

The Van Horn Woolen Company, Denver, Col., has filed its articles of incorporation, with a capital of $7,000.

The Maist & Gorten Machinery Manufacturing Company has been incorporated at Warsaw, Ind. Capital, $25,000.

New machinery is to be placed in the paper-mill at Watertown, N. Y., and the capital has been increased to $50,000.

The capital stock of the Chicago Insulated Wire Company, Chicago, Ill., has been increased from $50,000 to $200,000.

The Ivanhoe Land and Improvement Company is negotiating for the establishment of a nail factory at Ivanhoe, W. Va.

The Russell & Erwin brass foundry at New Britain, Conn., has been torn down to make room for a larger building.

A steel plant is contemplated at Strasburg, Va., by W. G. Carroll, who, it is reported, has leased land with that end in view.

Charles Hillman & Co., shipbuilders, at Philadelphia, will add a two-story machine shop to their plant, 206x40 feet in dimensions.

W. F. Symons and others are reported as to organize a stock company for the purpose of erecting an ice factory at Brunswick, Ga.

Negotiations pend toward the establishment of a wire-drawing plant and nail factory at Scranton, Pa. James Nolan is the projector.

The Aeriation Company has been organized, at Ashland, Ky., with a capital stock of $1,000,000 to manufacture air-purifying machines.

A factory is reported as to be erected at Fort Worth, Tex., for the manufacture of the Stanley auger for artesian wells, windmills, etc.

A company is being organized at Collinsville, Ala., with a capital of $100,000, by J. B. Pyron, of Cincinnati, Ohio, to erect a cotton mill.

The Citizens' Rapid Transit Company, Nashville, Tenn., is reported as to put new machinery in and increase the capacity of its power plant.

A stock company has been organized to establish an iron foundry and machine shops at Asheboro, N. C. C. T. Maxton is secretary and treasurer.

The Missouri, Kansas & Texas Railway Company (office, Parsons, Kan.,) will, it is reported, erect roundhouse and machine shops at Trinity, Tex.

The Monarch & Eureka Company has been incorporated at Baldwinville, N. Y., with capital of $100,000, to manufacture hub boring machinery, etc.

The stockholders of the Battle Creek (Mich.) Machinery Company have voted to increase the capital stock of the company from $30,000 to $70,000.

M. P. Satterthwaite has opened an office at 173 Superior street, Cleveland, Ohio, to represent manufacturers of iron-working tools and machinery.

It is reported that Watts Brothers contemplate adding a Bessemer plant to their steel works at Middlesborough, Ky., at a cost of nearly $500,000.

A Northern party is in correspondence with the Knoxville (Tenn.) Chamber of Commerce, relative to the establishment of a stove foundry in Knoxville.

The citizens of Beaumont, Tex., have obligated themselves to raise a bonus of $50,000 to secure the erection of car works at that place by eastern capitalists.

The Alliance Manufacturing Company has been organized, at Stuttgart, Ark., to manufacture wind-mills, water-tanks, etc. The capital stock is $10,000.

The New Birmingham (Tex.) Pipe Works has been incorporated, with a capital stock of $50,000, to operate the pipe works lately mentioned as to be established.

The old Gephart foundry and machine shops, at Cumberland, Md., have been leased by a Pittsburgh firm, who, it is reported, will manufacture electrical supplies.

The Wheeland Automatic Fire Escape Company is a new concern, organized at Chicago, to manufacture fire escapes on the Wheeland patent. Capital, $250,000.

It is stated that the Clement Safe & Lock Company, of Cincinnati, Ohio, is investigating with a view of removing its safe and lock factory to Middlesborough, Ky.

At Battle Creek, Mich., the Battle Creek Machinery Company are increasing their plant by the erection of a building, 40x50 feet, as an addition to the present works.

The Exeter Machine Company, of Exeter, N. H., will build branch works at some points in the South yet to be selected, in order to meet the demands of their Southern trade.

Endeavors are now being made for the organization of a $25,000 to $50,000 stock company, to erect a cotton-yarn-mill, at Elberton, Ga. S. M. Pickens can give information.

The Lone Star Iron Company, at Jefferson, Tex., is endeavoring to secure there the establishment of car wheel works, and it is now thought that the effort will be successful.

The South Boston Iron Works, of South Boston, have been acquired by an English syndicate, who will also build the new works at Middlesborough, Ky., begun by W. P. Hunt.

The John E. Beggs Machinery and Supply Company has filed articles of incorporation at Paterson, N. J. The capital stock of the company is $25,000, of which $10,000 is paid in.

George Leverett, Charles McFarlane, J. T. Hunt and others, have incorporated the Orange Foundry and Repair Company, to erect an iron foundry and repair shops at Orange, Tex.

The Granulated Emery and Corundrum Wheel Company, of Chicago, has been incorporated, with a capital stock of $600,000, for the manufacture of grinding and polishing wheels.

The Globe File and Hardware Company, of St. Louis, Mo., has been incorporated, with a capital of $20,000. Incorporators are Charles H. Niekamp, Charles J. Bretcher and A. O. Rule.

It is stated that the Cumberland (Md.) Electrical Supply Company has been incorporated, to establish electrical supply works, making a specialty of manufacturing street railway motors.

The Sigourney Tool Company, Hartford, Conn., are erecting an addition to their machine shop, which will be ready about July 1. The extension is 85x32 feet, two stories high, of brick.

It is stated that the Alleghany Mining and Development Company has authorized its executive committee to close contracts for the erection of a rolling-mill and nail-mill in Clifton Forge, W. Va.

The new Charleston (W. Va.) Boiler Works, which were contracted for some weeks ago, are to be built at once. The workmen are now at work on the plant, and it is to be in operation within three months.

It is reported that the United States Iron and Tin Plate Company, at Demmler, Pa., will increase its capital stock to $500,000 in order to make extensive additions to its plant for the manufacture of tin plate.

The J. Morton Poole Company, of Wilmington, Del., is erecting a large addition to its machine shops. The addition is 150x80 feet, built of iron and brick, with a slate roof, and will be practically fire-proof.

The machine shops of the Norfolk & Western Railroad, at Bluefield, W. Va., are to be enlarged and improved till they will be among the most extensive in the State. The new shops will employ about 300 men.

Material for the plant of the Western Iron Company, which is to be removed from near Kansas City to Ivanhoe, Ind., is already on the ground. The company has secured a tract of forty acres for the new works.

H. C. Thomas, secretary of the Norwood Car Replacer Company, of Baltimore, Md., states that the company has made arrangements for the erection of a plant at Norfolk, Va., to manufacture its patent car replacer.

The Stearns Roger Manufacturing Company has been incorporated, in Denver, Colo., with a capital of $250,000, to take over the business of Stearns, Roger & Co., manufacturers of mining machinery, with works at Pueblo.

E. A. Schumaker & Co., Cincinnati, Ohio, have issued a new catalogue of drill presses, which they make in sizes from 14″ to 40″ swing, inclusive. Their drill presses have some features not common to others in the market.

The American Pneumatic Gate Company, of Chicago, has been incorporated, with a capital stock of $2,400, to manufacture gates for railroad crossings. Incorporators: Frank O. Lewden, Louis Shissler and Emery S. Walker.

The Bessemer City Mining and Manufacturing Company have been organized, and propose to build a new town at Whetstone Mountain, N. C., to be known as Bessemer City, and to erect iron furnaces and start other enterprises.

The Western Smoke Preventing Company, of Chicago, has been incorporated, with a capital stock of $6,000, for the manufacture of smoke preventers and machinery; incorporators, J. C. Nutting, S. V. Nagel and D. F. Flannery.

There is water-works agitation in West Branch, Mich.; Cassopolis, Mich.; Milan, Tex.; Buffalo, Minn.; Wrightsville, Ga.; Yankton, Dak.; Pueblo, Colo.; Staples, Minn.; Brownwood, Ohio; Grand Rapids, Mich.; Huron, Minn.; Guthrie, Oklahoma.

The Harney Peak Consolidated Tin Company will begin the erection of a tin concentrating plant of 2,500 pounds daily capacity at Hill City, S. D. The contract for the building of the mill has been let. A. W. Untermeyer, of New York, is president.

The Western Iron Company, of Rosedale, Kas., manufacturer of bar-iron, nuts, bolts, etc., is to be located at Kenilworth, Ind., on the Michigan Central Railroad. The company will move as soon as the buildings are prepared, and will begin operations with 350 employes.

The Maryland Tube and Iron Works has been incorporated, with H. O. Chapman, of Philadelphia, Pa., as president; J. B. Hayes, of Norristown, Pa., vice-president, and O. C. Knipe, of same place, secretary, to establish pipe works at Hagerstown, Md. The capital stock is $60,000.

Gen. J. T. Wilder and others, of Johnson City, Tenn., are negotiating with J. E. Keller, of Louisville; B. R. Hutchcraft, of Lexington, Ky.; H. H. Talmadge, of Washington, D. C., and others, with a view of securing the building of large steel works. The prospects of success are reported as very good.

The Saline Iron Works, at Warren, Ark., have been organized, with J. W. Martin, president; J. R. S. Meek, vice-president, and J. M. Bailey, secretary, with a capital stock of not more than $25,000. This company is reported as having purchased the Warren Iron Works, and as to enlarge and operate same.

Robert J. Kragne, chief of the fire department of Pueblo, Colo., has placed on the market, through E. B. Preston & Co., of Chicago, Ill., what is called a "one-arm electric wire cutter." It is so constructed that, by the use of one hand, electric wire can be cut up to ⅝ inch diameter, with entire safety.

E. E. Ries, L. S. Greenfielder, O. M. Dennis, and others, have incorporated the Ries Electric Specialty Company, at Baltimore, Md., for the manufacture, sale and installation of electrical apparatus. The capital stock is $25,000. E. E. Ries is president; L. S. Greenfielder, vice-president, and Leopold Ries, secretary.

Frank C. Douds & Co., machinists and dealers in small supplies of all kinds, have recently purchased a site of land at New Castle, Pa., on which they propose erecting a strictly fire-proof machine shop, warehouse, engine and boiler-room, offices, etc. The buildings will be of stone, brick and iron, and will probably be completed the latter part of this year.

Barbour, Stockwell & Co., Cambridgeport, Mass., iron founders and machinists, have recently erected new buildings. The new plant consists of a foundry, 175x75; machine shop, 100x50, three stories, and pattern storage building, 100x60, three stories. The specialties of this concern are railroad castings and machinery for bread and cracker baking.

Advices from New Castle, Pa., under date of 19th inst., state that stock to the amount of $219,000 has been subscribed toward the erection of a new steel plant in that city. It was stated that the new concern will be composed exclusively of New Castle capitalists. It is understood that the New Castle Wire Nail Company of that place will be largely interested in the new venture.

The Hoppes Manufacturing Company, Springfield, Ohio, have just finished and shipped what they believe to be two of the largest live steam feed water purifiers ever constructed. They are 68 inches in diameter and 26 feet in length, 1,000 horse-power capacity each. These purifiers were designed and built for the Louisville Gas Company, Louisville, Ky., and are to be placed in the new electric light station being erected by that company.

A plant to make 400 tons of steel per day is the latest of New Castle's (Pa.) proposed industries. The company will be capitalized at $400,000, a large portion of which has been subscribed. The product of the plant will be used to a great extent in the industries at New Castle, principally the rod-mill, and the pig-iron will be supplied by the local furnaces. Operations will begin early in July on the erection of the plant. It is said that at first two 5-ton converters will be erected.

The engine department of the Hill Machine Works, of Florence, Mass., has been reorganized and incorporated into a stock company, with a cash capital of $100,000, under the name of Ulrich Engine Company. The officers of the new company are A. G. Hill, president; M. Ulrich, vice-president and superintendent; C. H. Clute, treasurer and general manager. New shops are being erected, consisting of a main brick building, 50x112 feet; also smaller buildings, containing the pattern shops, pattern house and testing rooms.

The big plant of the Kansas City Car and Wheel Company, at Birmingham, which has been closed since the first of last February, will be opened up early in July by the Missouri Car and Foundry Company, of St. Louis. The plant of the Kansas City company was sold at private sale to the St. Louis company last February, and it has been known all along that as soon as the money market eased up the foundry would be opened again. It is expected to start the plant going with 100 men employed. Orders for wheels sufficient to keep that force busy have already been received, and the force of men will be increased as rapidly as business justifies it. In all probability 200 men will be at work in a short time.

Test of a Triple-expansion Engine.

We give below an abstract of the paper presented under the above title at the Providence meeting of mechanical engineers, by J. T. Henthorn, also the discussion, in part. The engine was designed by Mr. Edwin Reynolds, of the E. P. Allis Company, and built by that company for the Narragansett Electric Lighting Company, of Providence, R. I.

The engine has cylinders 14″, 25″ and 33″ diameter, and each 48-inch stroke. The frame of the engines is formed by two forged iron guide-rod bars, each 4½″ square, which are secured to the lugs on the cylinder and main pillow block. Both guide-rod bars have a heavy support underneath at the center, which in turn is secured to the foundation by anchor bolts. The guides are formed by cast-iron V strips bolted on top and bottom of the bars, and can be removed for repairs at pleasure. The high-pressure and intermediate cylinders work tandem on one crank, with the high-pressure cylinder astern, and the low-pressure cylinder works upon a second crank set at right angles to that upon the opposite end of the crank-shaft. The intermediate and low-pressure cylinders have each two piston rods, each pair of rods passing through their respective crosshead, with the crosshead pin intervening between the ends of the rods. For the one piston rod of the high-pressure cylinder, connection is made to the center of the piston of the intermediate cylinder, and is secured thereto by shoulder and nut. The wrought-iron crosshead is what might be termed of the steamboat type, having the pin at the center and each end turned to fit the shoes or slide of the guide rod.

All the cylinders are steam-jacketed by forcing a working barrel or liner into the cylinder proper, and then making the ends tight by staking a copper ring into a recess or groove cut equally in width in the end of the liner and cylinder casting. The heads of each cylinder form the casing for the Corliss type of valve, and through which steam and exhaust passages communicate with corresponding steam passages in the cylinder casting. All of the steam valves are double-ported, to admit of a greater port opening with a minimum valve travel. Excepting the surface of the cylinder head forming the steam chests for the valves, they are not steam-jacketed.

The receivers, of which there are two, are each made of welded wrought-iron tube 20″ in diameter, which is enclosed in a similar tube 24″ in diameter, thus leaving 1⅞″ space between the outer and inner shell, through which circulates the jacket steam at boiler pressure. The course of this steam through the receivers and jackets of the several cylinders is as follows: Steam is taken from the main steam pipe to the jacket of the second receiver; the drain from this thence goes to the jacket of the first receiver, from this to the high-pressure cylinder jacket; thence to the jacket of the intermediate cylinder, and finally through the jacket of the low-pressure cylinder, from which, by means of a pump of short stroke worked by the engine, the water of condensation is thus returned to the boilers through the regular channel.

The cut-off mechanism of the high pressure and the intermediate cylinder is actuated by and under the control of a fly-ball governor; when desirable, this controlling mechanism may be disconnected from the intermediate cylinder at pleasure, and the point of cut-off fixed by hand adjustment for that cylinder, and entirely independent of the action of the governor. For the low-pressure cylinder the cut-off is determined at pleasure by hand adjustment only, and is always independent of the action of the governor. This arrangement admits of such a nicety of adjustment in each of the cylinders as may be desirable for any load and pressure, while at the same time the engine is perfectly automatic in its accommodation to the variable load always present in work of this character.

Steam is taken from a welded 18-inch pipe, which also is the feeder for two other

engines, and is ultimately intended for still more. There were no means for separating the moisture from the steam before entering the engine, nor for removing any water of condensation from the steam after leaving one cylinder and before entering the next one. This condition of things was from necessity, as the size of the steam pipe was made to accommodate one-half of the ultimate capacity of the station, and in this particular test was far in excess of any requirements of the engine. This, of course, caused condensation in the line, notwithstanding that it was covered by a plastic cement, and these circumstances worked together to the detriment of the engine very materially.

The engine exhausts into the condenser through a 26-inch cast-iron pipe, which also is common to all engines of the station. The condensing apparatus is entirely independent of the main engine, and consists of a condenser 9 feet long, 6 feet wide and 8 feet high, and contains 2,496 square feet of cooling surface. These tubes, which are $\frac{13}{16}$" and 1¼" in diameter, placed one inside of the other, are suspended vertically from brass plates, with their upper ends expanded therein. The plates for supporting the smaller tubes are some 8 inches above those for the larger or cooling pipes. These tubes are arranged in six sections of 208 pipes in each section, the water of condensation passing downward through the 1¼-inch tubes, thence upward through the small tubes, where it then crosses over to the next section, passing down through the small tube and upward between the large and smaller tubes, where it again passes forward, the operation being repeated until the water has traversed six sections, when finally it passes overboard to the river by an 18 inch cast-iron pipe, whose end is submerged about 4 feet below low water, and consequently acts as one leg of a siphon. The engine for working the air and circulating pumps is upright, of the Corliss type of valves, closed by vacuum pots, the same as the valve gear of the large engine, and is 12" diameter and 16-inch stroke. This cylinder is not steam-jacketed, but is well lagged with plastic material and mahogany wood covering. The exhaust steam from this condenser engine passes into the first receiver of the main engine, and is thus again utilized in the intermediate and low-pressure cylinders. This fact of the test precluded the laying out of a combined indicator card from the three cylinders.

There are two pumps, of which there is one air-pump, 24" diameter by 16 inch stroke, of the lifting bucket type, without foot valves, and one, 16" diameter by 16-inch stroke, plunger circulating pump. Between the air and circulating pumps is located, on the overhead crank-shaft, a plain fly wheel 10 feet in diameter, the center of the shaft being 10' 1" above the floor. This condensing apparatus is intended to receive the exhaust steam from several engines, as the growth of the station may require, as well as from the one tested.

All oil used in lubricating the working parts of the engine is drained back into an oil well located under each pillow block. From these wells, after passing through a suitable strainer, it is drawn by a small pump, worked by the rocker arm on the high-pressure side, and forced through a system of pipes back again to the working parts. The supply at any point is controlled by a valve, and so a steady and constant flow of oil is maintained at all places requiring lubrication.

METHOD OF TEST.

The author describes very minutely the methods of making the test, and arriving at conclusions.

It was found inexpedient to measure the feed water, on account of leakage from the boilers, and, therefore, arrangements were made to weigh the water discharged from the engine after passing through the surface condenser. The ordinary hot well discharge was blanked off from its regular course, and the necessary pipes and valves fitted to discharge the water from the surface condenser into two weigh tanks alternately. The water, after being drained from each of the alternate weigh tanks, was then taken by the feed pump and discharged through a meter as a check on the weighing, when it finally passed to the river. The temperature of the hot well water was taken at the time of each weighing of the water tank.

The jacket water pump of the engine was disconnected, and during the test the drainage from the receivers and jackets was regulated by hand, so as to keep the water at a given height, as shown by a glass gauge in the system of jacket piping, to prevent steam from being discharged with the jacket water. Two weigh tanks were provided for measuring this water. Each tank was partially filled with cold water from the city mains, and its weight and temperature noted. The condensed steam from the jackets and receivers was then allowed to run in until the tank was nearly full, when it was turned into the other tank, which had previously been supplied with cold water, and the weight and temperature of the mass again noted. The water was then emptied into the tank from which the feed pump drew its supply, and was passed through the meter with the hot well water.

As the condensing water, drawn from the river, was salt water, it afforded a means of detecting any leakages which might be in the surface condenser from the salt water side. Therefore the hot well water was frequently tested by nitrate of silver, but no leakage was found during the test. The condenser was also tested previous to the engine test, and found to be perfectly tight.

Following is the result of the test:

Test began at	9.30 P. M.
Test ended at	7.30 A. M
Duration of test	10 hrs. 0 m.
Revolutions of main engine, total	59,376
Revolutions of main engine, maximum per minute	99 33
Revolutions of main engine, minimum per minute	99.10
Revolutions of main engine, average per minute	99.12
Revolutions of condenser engine, average per minute	61.29
Steam pressure at engine throttle, per gauge, maximum	128 lbs.
Steam pressure at engine throttle, per gauge, minimum	110 lbs.
Steam pressure at engine throttle, per gauge, average	125.2 lbs.
Steam pressure at first receiver, per gauge, average	26.98 lbs.
Steam pressure at second receiver, per gauge, average	1 70 lbs
Vacuum at condenser, maximum	26 7 ins.
Vacuum at condenser, minimum	25 8 ins
Vacuum at condenser, average	26 5 ins.
Barometer, average	30 08 ins.
Temperature of injection water, average	72.00° F.
Temperature of discharge water, average	86.06° F.
Temperature of hot well water, average	109 06° F.
Temperature of engine room, average	90.00° F.
Indicated horse-power, main engine, maximum	529.7
Indicated horse-power, main engine, minimum	502 2
Indicated horse-power, main engine, average	515.70
Indicated horse-power, condenser engine, maximum	17.6
Indicated horse-power, condenser engine, minimum	14.8
Indicated horse-power, condenser engine, average	16.41
Indicated horse-power, aggregate, average	532.11
Water discharged from hot well, total	63,684 lbs.
Water discharged from jackets, total	10,653 lbs.
Water discharged from engine, total	74,337 lbs.
Percentage of total steam used in jackets	14.33%
Water entrained in steam, per calorimeter test	7.39%
Water entrained in steam, per calorimeter test	5,497 lbs.
Net steam used by engine	68,840 lbs.
Steam per indicated horse-power per hour	12.94 lbs.

Referring to the results as given above, the author says:

In determining the duty of this engine as given in the general summary, the power developed in the engine of the condensing apparatus and that of the main engine has been used collectively, and thus treated as one engine; and this factor, when divided into the total water, which includes all that discharged from the surface condenser, and that also from the two receivers and the three cylinder jackets, gives as a result 12.94 pounds of water per indicated horse-power; this is accomplished with exceedingly wet steam, and of 125 pounds pressure only.

The engines were originally designed, however, to carry a working steam pressure of 160 pounds, as that was fixed by the mechanical engineers of the electric station as the ultimate pressure for all machines; and I feel quite confident that, with that pressure and dry steam, only 12.6 pounds of water would be required per indicated horse-power.

DISCUSSION.

PROF. JACOBUS: In connection with this paper of Mr. Henthorn's it may be interesting to know the results obtained in a test made on a triple-expansion engine by Prof. W. Schroter, of the Munich Polytechnic School, in 1889. The results obtained in those tests, which were made in the most careful way, fall directly in line with those given by Mr. Henthorn, and thus add one more item to the problem of the triple-expansion versus the compound engine. The engine was located at an iron works in Hugsburg, and had the following dimensions: Diameter of cylinder, 11.1", 16" and 27.6"; stroke of all pistons, 39.4". The boiler pressure was about 145 pounds per square inch. Total horse-power of engine about 200; revolutions per minute, 70. Five tests of from five to six hours' duration were made, which agreed very well with each other, and gave an average of 12 6 pounds of steam per hour per horse-power, including all the steam condensed in the receivers and jackets. The cylinders and receivers were jacketed with steam at full boiler pressure. A separator was placed on the steam pipe near the engine, and the water drained from it was weighed and deducted from the water weighed to the boilers, in order to obtain the water used by the engine.

MR. KENT: I see the paper states that the presence of moisture in the steam most seriously affected the economic action of the steam with which it was mixed, and amounted to much more than there credited for water thus found. I think there is a chance for a difference of opinion on that, and I would like to call the attention of the writer to that fact, and ask him to please state proofs in his reply to the criticism.

MR. HENTHORN: In regard to that moisture, it was considered by Mr. Leavitt and myself that it did have a serious effect on the economy of the engine—much more than the credit that was given. That may be, as Mr. Kent states, open to various judgments, but we thought that it acted as a handicap to the engine in its performance.

MR. WHEELER: I would like to ask Mr. Henthorn one or two questions, but before doing so I would remark that I hope that some one will have noted some of the details of this engine. For instance, the valve arrangement in the head, of course, giving the minimum clearance; also, the high rotative speed, practically 100 revolutions a minute. The piston speed—800 feet—of course, is not so uncommon. The question I wished to ask Mr. Henthorn was in relation to the independent pumping engine. I notice here that the horse power of this engine was somewhat over three per cent. of the main engine — in other words, over 16 horse-power. Did you try to run that engine slowly, and yet maintain a satisfactory vacuum and temperature? Three per cent. is rather large for an independent engine of the kind. In most modern naval practice all auxiliaries of the ship rarely exceed two per cent., including the blowing engines, the steering engines, and all pumps. I would also mention that in these cases there are independent air-pumps, as in this. It would, of course, help very much the economy of the general showing here, which Mr. Henthorn only marks 12.6 pounds, while it was approximately 13 pounds. It occurred to me that it might have helped the result by not running the independent engine quite so fast. Being interested in the matter of surface condensers, I want to remark that placing tubes vertically handicaps the condensers. My own experience, and that of Mr. Clark in England, shows that tubes placed horizontally will do at least fifteen per cent. more work than those placed vertically.

MR. HENTHORN: In regard to the size of the condensing apparatus, requiring, as the gentleman states, about three per cent. of the whole power, I would state that the machine was designed for a capacity of about 2,500 horse-power, which included the first engine which was tested, and other engines which were to be put into the station. We have recently added an engine of the same type, of 1,200 horse-power, and that is to go on the same condensing apparatus which we used for the 500 horse-power engine. So that that percentage would be reduced very materially when we get 2,000 or 2,500 horse-power in the station.

MR. WHEELER: I might say that I have no doubt you could reduce that more than one-half. I have seen an independent engine carrying the air and circulating pumps produce a result as low as one per cent.—a little less than one per cent.—of the main engine power.

MR. HENTHORN: That would bring it a little less than one if we had 2,000 horse-power in the station, which that condensing apparatus is ample for.

It has been determined to send to the World's Fair as a feature of the Government exhibit, the largest specimen that can be obtained of the famous big trees of California. A tree thirty feet in diameter, which is about the largest size that grows, will be selected, and the limbs cut-off thirty feet from the ground. The trunk will then be sawed into sections and the outside piece only sent to Chicago. On arrival at the exhibition the pieces will be put together so that the outside portion of the tree, several feet thick and thirty feet high, will stand just as it did in the forest. In order to cut the tree into sections it will be necessary to have a special saw made, about fifty feet in length, which will be operated by machinery that must be taken into the forest especially for that purpose. It is proposed at present to place it in the center of the rotunda of the government building, which will be 120 feet in circumference. The interior of the tree will be decorated with cones, leaves, and other attachments of the tree, divided into rooms, and the whole illuminated with electric lights.—*Wood Worker.*

Mr. J. Hickey, superintendent of motive power of the Northern Pacific Railroad, recently expressed himself as follows at a meeting of the Western Railway Club:

"It is the opinion of many that the dome is a means of supplying dry steam to the cylinders. Now, while this may be a fact when the domes are located only a short distance from the heating surface, it is not true when the domes, as in the case of many boilers, are located some distance therefrom. The fact is that a high dome situated some distance from the heating plates, instead of furnishing dry steam to the cylinder, as is usually expected, delivers steam of a moist character, particularly so if it is not perfectly and fully covered with non-conducting material to protect it from the surrounding atmosphere. Sufficient steam room between the surface of the water and the shell is a far more desirable place in which to store steam. Domes of course afford a convenient means for throttle valves and other attachments, but they should be no higher than is absolutely required."

Mr. N. S. Possons, formerly superintendent of the Brush Electric Company, Lynn, Mass., has made an engagement with the Eureka Tempered Copper Co., of North East, Pa. He enters the employ of the last named company as general sales agent.

It is said that the Standard Oil Company has determined to vigorously prosecute the sale of oil in Europe, in opposition to Russian competition. Of course it will be interesting to compare the prices of the Standard Company's oil in Europe and America.

Machinists' Supplies and Iron.

NEW YORK, July 2, 1891.

Iron—American Pig—There is a moderate degree of activity in the market.

We quote: No. 1 Foundry, Standard Northern brands, $16 50 to $18; No. 2 is selling at $16 to $17, and Gray Forge at $13.90 to $14.50. Southern brands of good quality are obtainable at $16 to $17.50 for No. 1 Foundry; and $15.75 to $16 for No. 2; and $14 to $14.50 for No. 3.

Scotch Pig—We quote at $24.50 for Coltness; $22 for Dalmellington; and $20.50 for Eglington.

Copper—The market for Lake copper continues quite dull, and prices are somewhat easier. Lake can now be had at 13c., and bids are at 12.50c.

Lead—The supplies of pig lead are somewhat short, and prices are firmly maintained. Values for car lots, spot, are at 4.45c. to 4.50c.

Spelter—There is not much doing in the way of trade, and values are nominal at 5c. to 5.05c.

Tin—The market is quiet, and prices not so firmly maintained. Values are at 20.25c. to 20.35c.

Antimony—The market is somewhat irregular.

We quote Hallett's at 12½c. to 13c.; Cookson's, 14½c. to 15c.; and 13c. for L. X.

Lard Oil—Prices are maintained at 52c. to 53c. for City, Western at 51c.

WANTED

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Agents wanted in every shop for fine surface gauges. Address E. G. Smith, Columbia, Pa.

Wanted—Progressive, energetic machinist, as foreman in bicycle factory. Mfr., AM. MACHINIST.

Experienced molder, with $3,000, to take a one-half interest in a well established western foundry and machine shop. Address Box 12, AM. MACH.

Place wanted as superintendent or assistant; experience, designing and building special and regular machine tools. Address A. T. O., AM. MACH.

Draftsman who is familiar with engine work, general machinery and designing, desires a position. Address "Lilly," 351 Rookery, Chicago.

Wanted—A general blacksmith, good, all-round man; good wages. Apply to the Merrill-Stevens Eng. Co., Jacksonville, Fla.

Experienced mechanical draftsman, age 26, technical school graduate, with shop experience, wants permanent position. Address Box 14, AM. MACH.

Sit wanted as foreman; all-round exp.; blacksmith line, hammer & drop; also presses, die-hardening, &c.; good ref. J. L. R., Hartford, Conn.

The superintendent of a boiler works, who is a prac. man and accustomed to all classes of work, is desirous of changing, & invites correspondence for his services. Loco. work preferred. Supt., AM. MACH.

Wanted—A draftsman and designer; one capable of taking charge of a drawing-room, and having experience with pumping machinery preferred. Address The Ahrens Mfg. Co., Cincinnati, Ohio.

Wanted—At Pittsburgh Locomotive Works, Pittsburgh, Pa., a competent foundryman to take charge of iron and brass foundries; must be active, entirely temperate, and thoroughly understand locomotive work; state salary expected, and give references.

Wanted—A sober, energetic young man, good engineer and machinist, who can operate a Miller & Bierce steam and hydraulic cotton compress successfully; also take charge of labor around the compress, commencing August 15th inst.; salary $75 per month. Address, with references, Union Compress & Warehouse Co., Macon, Ga.

Wanted—By a western technical school, an instructor in pattern making and wood work, one capable of organizing and directing a systematic course of training; also a brass molder thoroughly posted in the various branches of foundry practice, and capable of giving instruction in same. Address, with references, A. W. Bradley, AM. MACHINIST.

A gentleman long identified with the machinery business, or steam electrical work, in all their branches, fully qualified, able to erect plants, desires to represent some large manufacturing company as agent in New York City, or to represent a like concern at the coming Fair in Chicago; highest references as to character and ability. Box 13, AMERICAN MACHINIST.

A mechanical engineer, now holding responsible position in a large manufacturing concern, desires to make a change; experienced in modern economical methods of manufacture, and especially so in producing machinery and its products in quantities, where jigs and duplicating machinery is required; also in the erection and testing of steam plants, and in operating them to their highest economy, and in the manufacture of wire and wire-working machinery; will be pleased to correspond with any party having a responsible position open who requires the services of a competent, energetic man. Address A. S. M. E., care AM. MACHINIST.

MISCELLANEOUS WANTS

Advertisements will be inserted under this head at 35 cents per line, each insertion.

Cheap 2d hd-lathes & planers. S. M. York, Clev'd, O.

Auto. Steam Flue Cleaners. Kelley Co., Erie, Pa.

Light and fine machinery to order; Foot Lathe Catalogue for stamp. E. O. Chase, Newark, N. J.

Best Bolt Header in the world for $50. Address C. H. Baush & Sons, Holyoke, Mass.

Wanted—Specialties to build for the Southern trade. Bluefield Iron Works, Bluefield, W. Va.

Special leather and cement for covering pulleys; no rivets required; local agents wanted. Crescent Mfg. Company, Cleveland, Ohio.

Engine for sale; 55 H. P. Watts-Campbell slide valve engine in good order; will be sold cheap. F. Berg & Co., Orange Valley, N. J.

One Wright automatic engine for sale, in good condition; cylinders 15"x32". Can be seen at 251 Greenpoint avenue, Brooklyn.

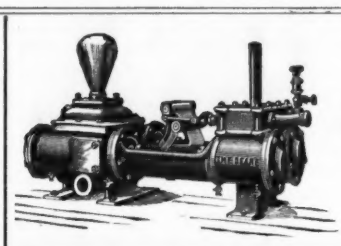
Wanted to rent, small machine shop; must be well located, doing engine and repair work. Address J., AMERICAN MACHINIST.

For Sale—Three 3-ton jib cranes. 20 ft. height of mast, swing in space of 35 ft. Can be seen in position until July 15th at works of The J. Morton Poole Co., Wilmington, Del.

Wanted—Two practical machinists to take half-interest in foundry and machine shops, having excellent facilities for doing good work, manufacturing and jobbing. P. M. Trumbower, Muncy, Pa.

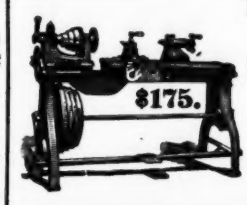
Wanted—Engineers to write for catalogue of all the latest and most valuable mechanical, scientific and electrical books which are given free with each barrel of the Pittsburgh Boiler Scale Resolvent. Pittsburgh Boiler Scale Resolvent Co., Pittsb'gh, Pa.

Wanted—Wm. Rontree, engineer, who was employed in our works during 1886 and 1887, will hear of something to his advantage by addressing us at once. Any information of the above will be thankfully received at the Fulton Iron Works, Second and Carr streets, St. Louis, Mo.



THE DEANE
OF HOLYOKE
STEAM PUMPS
DEANE STEAM PUMP CO.,
HOLYOKE, MASS.

CRESCENT STEEL CO.
Pittsburgh, Pa.
Chicago, Ills.
New York, N. Y.
TOOL & DIE STEEL
of Uniform Quality and Great Strength.



Improved Screw Cutting Foot and Power. LATHES
Drill Presses, Shapers, Band, Circular and Scroll Saws. Machinists' Tools and Supplies. Lathes on trial. Catalogue mailed on application.
THE SEBASTIAN-MAY CO.,
167 to 175 Highland Avenue, SIDNEY, OHIO.
MONTGOMERY & CO., 105 Fulton St., New York, Gen'l Agents.

Fine Taps, Dies, Reamers, Etc.
Lightning and Green River Screw Plates.
Bolt Cutters, Hand and Power Drilling Machines, Punching Presses, Tire Benders, Tire Upsetters and Other Labor-saving Tools. Send for Price List
WILEY & RUSSELL MFG. CO., GREENFIELD, MASS.
New York Agency, No. 126 Liberty Street.

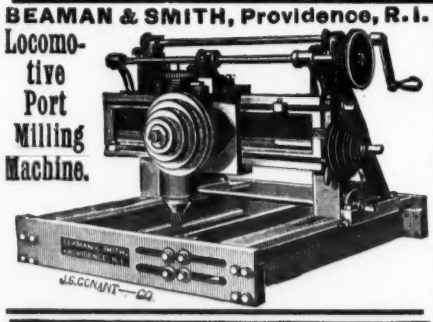
PRACTICALLY DEMONSTRATED.
THE HACKNEY POWER HAMMER
is meeting with DESERVED SUCCESS, and an investigation as to its principle of operation and construction will convince any one beyond question of its superiority in every respect over the old-fashioned-helve-rubber cushioned-leather strap-awkward belt tightener power hammers sold to-day. All such old fogy and frail appliances are done away with in the "HACKNEY," and the purchaser gets for his money a vastly more EFFECTIVE and DURABLE HAMMER.
That the "HACKNEY" is far ahead of any other power hammer in the market is PRACTICALLY DEMONSTRATED, and we have strong testimonial letters from leading firms throughout the country who have used them.
Write for Illustrated Catalogue with Description and Prices.
THE HACKNEY HAMMER COMPANY, Cleveland, Ohio.

The Bradley Cushioned Hammers
Never Questioned.
The superiority of the Bradley Hammers has never been questioned. Some think the price is a little high, but no other manufacturer furnishes as much. Anvil block made separate, not cast in one piece with the main frame. Wide eccentric and strap, not a little crank pin. Slip sleeve for instantly changing length of stroke. Rubber cushions to absorb the concussion. Helve, Upright and Beaudry styles. Send for catalogue.
BRADLEY & CO., SYRACUSE, N. Y. Branches at 14 Warren St., N. Y., and 96 & 98 Sudbury St., Boston.

JESSOP'S STEEL
For TOOLS, DRILLS, DIES, &C.
All Kinds in Stock.
Gold Medal, Paris, 1889.
MANUFACTORY,
WILLIAM JESSOP & SONS, LD. | SHEFFIELD, ENGLAND. | Chief American Office, 91 JOHN ST., NEW YORK.

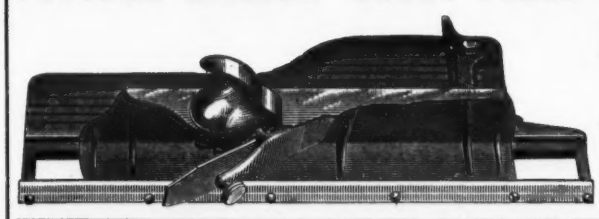
R. MUSHET'S SPECIAL and TITANIC STEELS.
How to get the best results with "R. MUSHET'S SPECIAL STEEL." Greatly increase your speeds and feeds then compare the work you turn off with that done by any other known Steel. This will make the first cost of "Mushet's" look insignificant.
B. M. JONES & CO.,
Sole Representatives in the United States.
11 & 13 Oliver St., BOSTON, MASS.
143 Liberty St., NEW YORK.

BEAMAN & SMITH, Providence, R. I.
Locomotive Port Milling Machine.



CHORDAL'S LETTERS
To Mechanics,
Reprinted from AMERICAN MACHINIST.
12mo. cloth, $2.00.
JNO. WILEY & SONS,
NEW YORK.

PATTERN MAKERS' SHOOT PLANE & JACK BOARD.



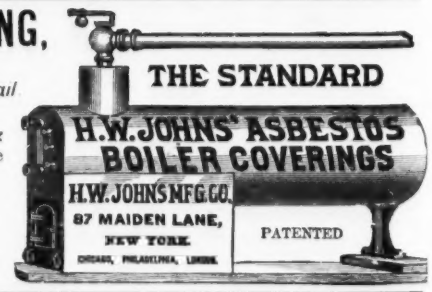
A. J. WILKINSON & CO.
Box 3600.
BOSTON, MASS.
SEND FOR CIRCULAR.

STEEL TUBES
WELDLESS
SMOOTH · COLD DRAWN
John S. Leng's Son & Co. New York.

Montgomery & Co.
Machinists' Tools
AND SUPPLIES.
105 Fulton Street,
NEW YORK CITY.

FOR SALE CHEAP
A screw-cutting foot lathe manufactured by F. E. REED, of Worcester, Mass.; 10-inch swing, 4-foot bed; weight, 600 lbs., with one 9-inch WESTCOTT 4-jaw independent and universal chuck, one Little Giant drill chuck, holds square work, two face plates, steady rest centers, etc., etc. Lathe just as good as new. Can be seen at 252 West 35th St., New York City. Price $130 cash. Address Box 473, TRENTON, N. J.

ASBESTOS CEMENT FELTING,
FOR LAGGING LOCOMOTIVE BOILERS.
Samples and Descriptive Price List Free by Mail
We are prepared to take Contracts for applying Steam Pipe and Boiler Coverings in any part of the United States.
H. W. JOHNS MANUFACTURING CO.,
87 Maiden Lane, NEW YORK.

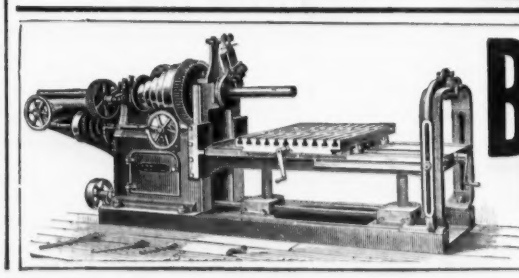


A NEW DISCOVERY
PREPARED BORAX.
Welds steel to steel at a Bright Red heat. Send for sample box, 10c. 25c. per lb.; goes 4 times further than unprepared Borax.
PREPARED BORAX CO.,
SOUTH BEND, IND.

FOR SALE CHEAP.
Complete set of Planer Drawings and Patterns, in sizes from 30 inches square to 8 ft. square, advancing by 6 inches.
HEWES & PHILLIPS IRON WORKS,
NEWARK, N. J.

C. H. DE LAMATER & CO.,
FOOT WEST 13TH STREET, N. Y.,
Offer remaining tools at the following prices:

1 De Lamater Horizontal Boring Mill, 62" swing, 18' bed, and with three boring bars,	$700.
1 No. 2 Silsby Rotary Pump,	20.
1 25-ton Traveling Crane, 20', 9½" span,	1,200.
1 25-ton Traveling Crane, 40' span,	900.
1 18-ton Traveling Crane, 40' span,	700.
Lot steel tools for Lathes and Planers. Your choice at 10 cents per lb., or the lot at less price.	
1 36" Dimpfel Blower,	20.
1 45" Dimpfel Blower,	25.
1 No. 6 Sturtevant Blower,	30.
1 700-lb. Binary Ice Machine, with boiler, pipes, etc.	
2 700-lb. Binary Ice Machines, to run with belt.	
Lot Propeller Wheels, from 22" to 8' 8" diameter, at half price.	
An assortment of Steam Pumps at very low price.	

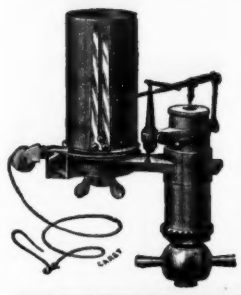


BETTS MACHINE CO.
Wilmington, Del.
MAKERS OF
HEAVY MACHINE TOOLS
FROM
New Designs and Patterns.

NICHOLSON FILE COMPANY,
PROVIDENCE, R. I.

FILES AND RASPS
FOR EVERY VARIETY OF WORK.

THOMPSON IMPROVED INDICATOR
MANUFACTURED SOLELY BY
American Steam Gauge Co.
5,000 IN USE.



Adopted by the U. S. Government for all the new Cruisers and Gunboats built for the Navy.

ALSO MANUFACTURERS OF
Pop Safety Valves, Steam Pressure Gauges, Etc.
No. 36 Chardon Street, BOSTON, MASS.
Send for Illustrated Catalogue *Y* free.

REDUCED PRICES OF LeCOUNT'S STRAIGHT TAIL DOG.

These goods are for sale by CHAS. CHURCHILL & CO., L't'd, 21 Cross St., London, England.

To be driven from a Stud in the Face Plate.

No.	INCH.	PRICE.	No.	INCH.	PRICE.
1.	¾	$0.60	10.	2¼	$1.35
2.	⅞	.70	11.	2½	1.45
3.	1	.70	12.	3	1.60
4.	1⅛	.80	13.	3½	1.80
5.	1¼	.80	14.	4	2.10
6.	1⅜	.95	15.	4½	2.75
7.	1½	.95	16.	5	3.25
8.	1¾	1.10	17.	5½	4.00
9.	2	1.20	18.	6	5.00
	1 Set to 2 in.	7.80		Full Set	31.10

C. W. LeCOUNT, South Norwalk, Conn.

---

15 Projected Railroads, 16,000 Miles River Navigation, Coal, Natural Gas, Coke, Oil, Clays, Glass Sand and Building Stone, Hard and Soft Wood Lumber, Iron from the South and Lakes at Lowest possible Cost are the resources at

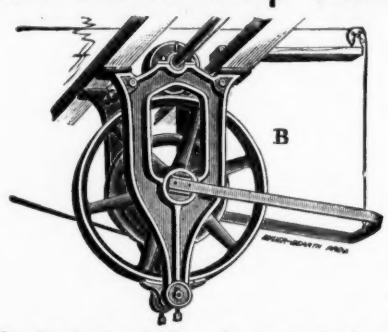
KANAWHA CITY, W. VA.

We want Manufacturers. This is a splendid point; one of the best in the U. S. for the **Manufacture of Machinery.** Cheap fuel. Cheap feights. Cheap raw materials. Cheaper than almost anywhere else. Free sites and liberal inducements, and incomparable advantages are offered. Write for prospectus and particulars. Address

B. D. AVIS, General Manager,
CHARLESTON, W. VA.

The **SUPERIORITY** of this Hammer is due to the excellence of design as regards
EFFICIENCY, Simplicity, and Durability.
L. & R. WISTER & CO.,
257 South Fourth Street, PHILADELPHIA, Pennsylvania, U. S. A.

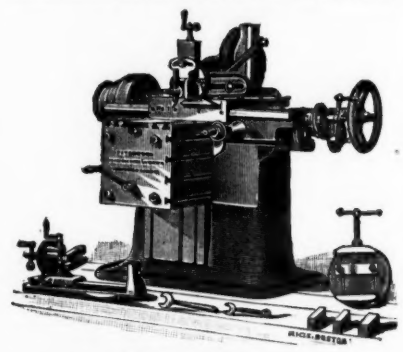
MASON'S
New Patent Whip Hoist.



One hundred and eleven in use at the largest new Hay depots in the World, of N. Y. C. & H. R. R. R. Co., 33d St. & 11th Ave., New York, and Lowell M. Palmer's Docks, North 9th and 10th Sts., Brooklyn, N. Y.

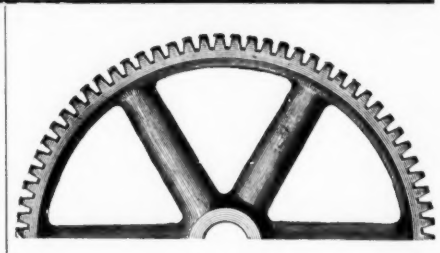
Made by VOLNEY W. MASON & CO.,
PROVIDENCE, R. I.

FITCHBURG MACHINE WORKS
Manufacturers of METAL-WORKING MACHINES.



OFFICE AND WORKS,
13 to 21 MAIN STREET, Fitchburg, Mass.
Send for Catalogue (E.)

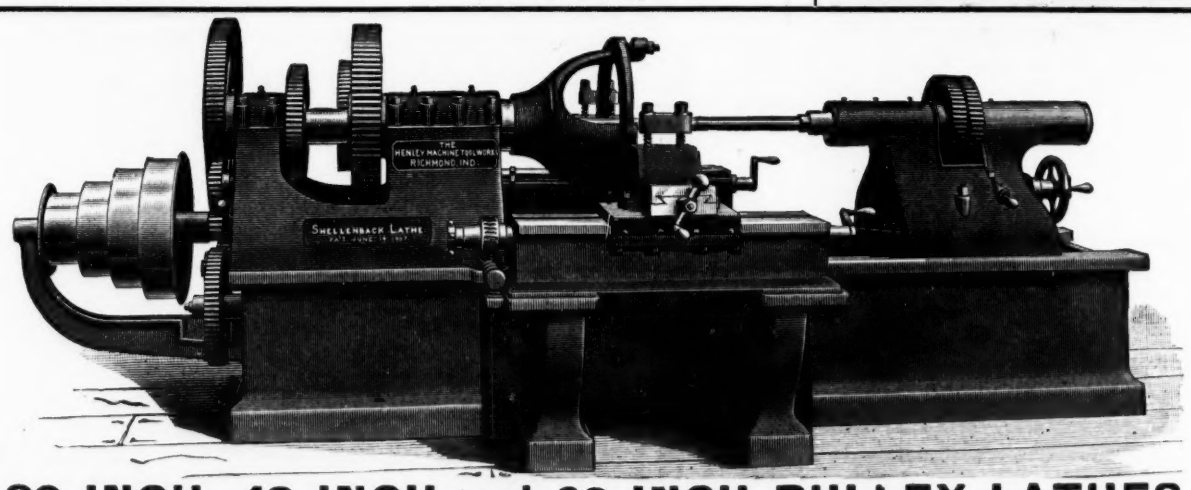
CHARLES MURRAY
ENGRAVER ON WOOD
58 ANN ST. NEW YORK.



GEAR CUTTING
GEAR CUTTING
GEAR CUTTING

LELAND, FAULCONER & NORTON CO.
DETROIT, MICH.

C. H. BAUSH & SONS,
HOLYOKE, MASS.
MANUFACTURERS OF
POST, SUSPENDED
AND
WALL RADIAL DRILLS
FROM THE SMALLEST TO THE LARGEST.



30 INCH, 42 INCH and 60 INCH PULLEY LATHES
For Simultaneously Boring and Turning Pulleys, both straight and crowning face, Cone Pulleys, Gear Blanks, and a variety of other work.
Manufactured by **The HENLEY MACHINE TOOL WORKS, Richmond, Ind.**

New Boring and Milling Engine, with new circular milling attachment.
The States Machine Co., Newark, N. J.
See their New Countershaft; Self-oiling Pulleys and Universal Joints.

BUFFALO BLOWERS.
BUFFALO FORGE CO., BUFFALO, N. Y.

THE "DODGE INDEPENDENCE"
WOOD SPLIT PULLEY
LEADS ALL OTHERS.
Combines LIGHTNESS with GREAT STRENGTH, CHEAPNESS and GREATEST EFFICIENCY.

Can be put on without disturbing the shaft and with the bushings will fit various sizes of shafts 6″ to 60″ diameter in stock.

COOKE & CO.,
MACHINERY & SUPPLIES.
163 & 165 Washington St., New York.
HEADQUARTERS FOR
Edison Hangers, Williams Leather Belting, &c.
Mention AMERICAN MACHINIST.

SEND FOR CATALOGUE.
WORCESTER MACHINE SCREW CO.

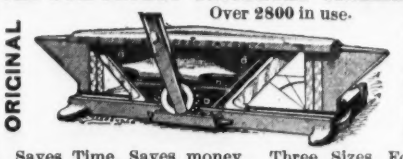
Manufacturers of Set, Cap & Machine Screws, Studs, etc.

THE BRITISH & EUROPEAN PATENT AGENCY,
F. W. BARKER, Manager, (Registered English Patent Agent, According to Act of Parliament,)
252 Broadway, New York.
Monument Chambers, King William St., London, E. C., England.

American and European Patents obtained at equitable rates. *Special Facilities for Sale of Foreign Patents through our London House. A good invention is worth as much in Great Britain as in the U. S.* Competent draftsmen employed on premises. We refer to well known men in the machine trades for whom we have done business.
Epitome of the World's Patent Laws and Statistics Sent Free on Application.

THE FOX PATENT UNIVERSAL TRIMMER.
Over 2800 in use.

ORIGINAL



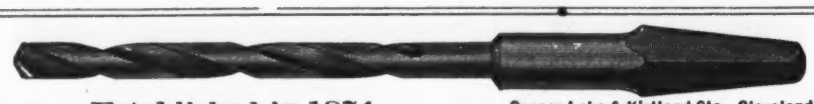
IMPROVED

Saves Time, Saves money. Three Sizes, Four Styles, from New Patterns. *No Pattern Room Complete without Them.* Send for Catalogue.
Beware of Imitations, we will prosecute all Infringements.
THE FOX MACHINE CO.,
325 North Front Street, Grand Rapids, Mich.

HENRY CAREY BAIRD & CO.,
INDUSTRIAL PUBLISHERS, BOOKSELLERS AND IMPORTERS,
810 Walnut St., Philadelphia.

☞Our New and Revised Catalogue of Practical and Scientific Books, 87 pages, 8vo., and our other Catalogues and Circulars, the whole covering every branch of Science applied to the Arts, sent free and free of postage to any one in any part of the world who will furnish his address.

WORTHINGTON
Independent Condenser
An Economical Addition to Steam Engines.
POWER GAINED or FUEL SAVED
AND
BOILER PRESSURE LOWERED
ESPECIALLY RECOMMENDED FOR
ELECTRIC LIGHT MILL BOAT and PUMPING ENGINES
HENRY R WORTHINGTON
NEW YORK
BOSTON PHILADELPHIA CHICAGO
ST LOUIS ST PAUL



Established in 1874. Corner Lake & Kirtland Sts., Cleveland, O.
100 & 102 Reade Street, New York.
85 Queen Victoria St., London, Eng.

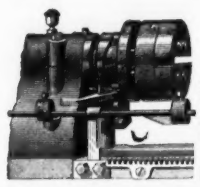
CLEVELAND TWIST DRILL CO.

HOWE'S STEEL. FOR TAPS, DIES, PUNCHES, CHISELS, DRILLS, LATHE TOOLS, &c.

ESTABLISHED 1859.

HOWE, BROWN & CO., L'T'D., PITTSBURGH, PA.

93 JOHN ST., NEW YORK. 127 OLIVER ST., BOSTON. 228 LAKE ST., CHICAGO.



ADAMS

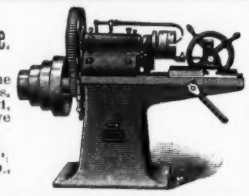
Automatic Bolt-Threading & Nut Tapping Machine.

Made in all Sizes to Cut from 1-4" to 6".

The simplest and most durable machine in existence. The threading head is made entirely of steel. No links, levers, springs, caps, cases, blocks or die rings in or about the head. Separate Heads and Dies Furnished. Write for descriptive circular and price list to

Capitol Mfg. Co., 125 to 137 Rees St., Chicago Ill., U. S. A.

Agents for Great Britain, CHARLES CHURCHILL & CO., Ltd., 21 Cross Street, Finsbury, London, E. C., England.

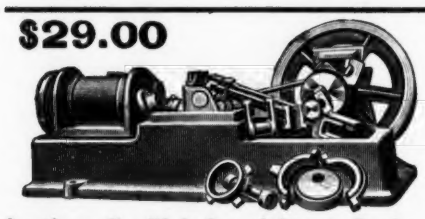


GRAHAM TWIST DRILL CO., Detroit, Mich., U. S. A.

Sole Manufacturers of GRAHAM'S PATENT GROOVED SHANK TWIST DRILLS & CHUCKS.

Endorsed by Practical Mechanics Everywhere. Send for Catalogue and Prices.

$29.00



Castings for High Speed Steam Engine.

CYLINDER 4 in. x 4¼ in.

T. Shriver & Co. Iron and Brass Founders,

333 E. 56th St., N. Y. City.

Sets of Castings for Engine illustrated above, with *Cast steel Shaft, Connecting Rod* and *Rock Shaft* and *Brass Bearings*, boxed and shipped on receipt of $29.00. Three sheets *blue prints* of working drawings, extra.

FRICTION CLUTCH PULLEYS and CUT-OFF COUPLINGS.

THE WOODCOCK CLUTCH

Simplest and best in the world. Address

ALLENTOWN FOUNDRY & MACHINE CO., ALLENTOWN, PA.

GLEASON'S

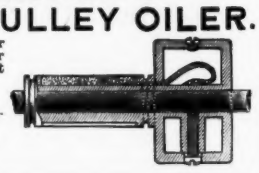
LOOSE PULLEY OILER.

Of the large number in use not one has ever failed to give perfect satisfaction.

E. & F. GLEASON,

Also, Mfrs. Wood-working Machinery.

2210 BODINE STREET, Philadelphia, Pa.



FOR

Substantial, Well Made, Low Priced, Patented,

20 Inch Drills,

With latest improvements, Lever, Combination or Wheel Feed, address

Sibley & Ware,

SOUTH BEND - INDIANA.

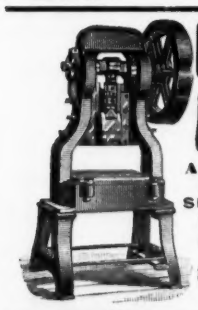
If you buy a KEY-WAY CUTTER without a KEY-MAKING ATTACHMENT

You will make a mistake that will cost you money.

THE MORTON Light Key-Way Cutter is the only machine on the market that will cut a Key-Way and make a Key to fit it. Mr. Geo. Newcomb, Salem, Mass., says as follows: "The Key-maker is a wonderful attachment, making keys faster than a man can cut off the steel for it. The Key-way Cutter does a piece of work in fifteen minutes which requires my man seven hours to accomplish by hand." We build machines with stroke varying from six inches to five feet, and cutting from the smallest Key ways to six inches wide.

MORTON MFG. CO., Muskegon, Mich.

Formerly of ROMEO, MICH.



POWER PRESSES

Adjustable. Improved.

FOR TIN, BRASS AND SHEET IRON WORKERS.

WORKMANSHIP GUARANTEED.

STRONG AND DURABLE.

Send for Circulars.

SPRINGFIELD MACHINE TOOL CO.

SPRINGFIELD, OHIO.

THE PECK PATENT DROP PRESS

MINER & PECK MFG CO.

SUCCESSORS TO BEECHER & PECK

NEW HAVEN, CONN.

DROP FORGINGS

THE **STILES & PARKER PRESS CO.,**

Middletown, Conn.

MANUFACTURERS OF

Presses and Dies, Drop Hammers,

SHEET METAL TOOLS.

WRITE FOR PRICES.

E. W. BLISS COMPANY, L'T'D.

BROOKLYN, N. Y.

Manufacturers of

HORIZONTAL BORING MILLS.

TOOLS FOR WORKING SHEET METALS,

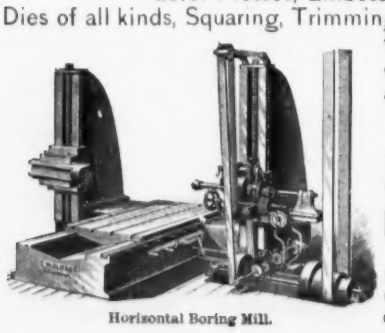
Drop Presses, Forging Presses, Drawing Presses, Lever Presses, Embossing Presses, &c., &c.

Dies of all kinds, Squaring, Trimming and Slitting Shears, for Rolling Mill and other Work, Tinners' and Canmakers' Tools.

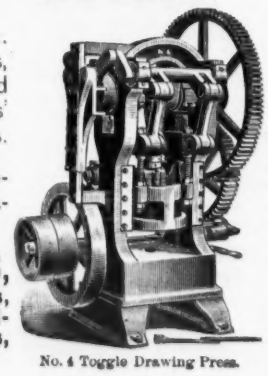
Vertical and Two-Spindle Milling Machines.

PUNCHES & SHEARS,

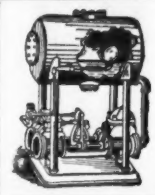
For Boiler Makers, Bridge and Ship Builders, Arch'l Iron Works, &c.



Horizontal Boring Mill.



No. 4 Toggle Drawing Press.



AUTOMATIC FEED PUMPS AND RECEIVERS

For returning hot condensed water to boiler.

STEAM PUMPS FOR ALL DUTIES.

THE BUFFALO STEAM PUMP CO.,

BUFFALO, N. Y.

THE CANTON STEAM PUMP CO., CANTON, OHIO.

Manufacturers of

STEAM PUMPS for EVERY PURPOSE.

BOILER FEEDERS A SPECIALTY.

NEW DESIGNS AND IMPROVEMENTS.

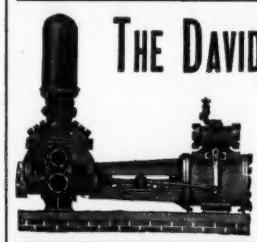
ABSOLUTELY FIRST CLASS.

Discounts and Terms on Application.

10 X 6 X 12

2¼ X 1⅞ X 2½

THE DAVIDSON STEAM PUMPS AND PUMPING ENGINES.



WARRANTED THE **BEST MADE** FOR ALL SITUATIONS.

Manufactured by

M. T. DAVIDSON.

PRINCIPAL OFFICE AND WORKS, 43-53 Keap St., Brooklyn, N. Y.

BRANCH OFFICES: 77 LIBERTY STREET, NEW YORK. 51 OLIVER STREET, BOSTON.

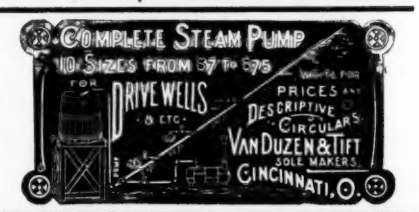
DUPLEX STEAM PUMPS. POWER PUMPS. PRESSURE PUMPS. INDEPENDENT CONDENSING APPARATUS

BARR PUMPING ENGINE CO.

GERMANTOWN JUNCTION, PHILADELPHIA, PENNA.

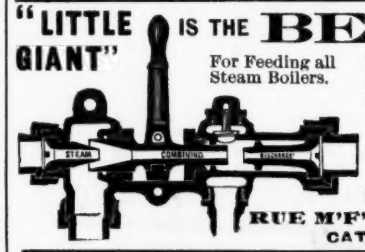
Maslin's Patent Steam Pump.

Cheapest and Best Automatic Steam Vacuum Pump. Handles DIRTY and GRITTY LIQUIDS without Oil or Care. Simplest, and most durable Pump made, as partial removal of two bolts makes every valve readily accessible. Pumping Plants for Contractors, Irrigation, Water Works, Railroads, Mining and General Hydraulic Purposes. Send for Circulars. JOHN MASLIN & SON, Sole Mfrs., 165-167 1st St, Jersey City, N. J.



"LITTLE GIANT" IS THE **BEST INJECTOR**

For Feeding all Steam Boilers.

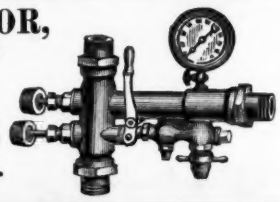


RUE'S EJECTOR,

Superior to all others for Raising and Forcing Water and other Liquids.

Boiler Washer and Testing Device.

Uses Warm Water, avoiding injury and facilitating the Raising of Steam.

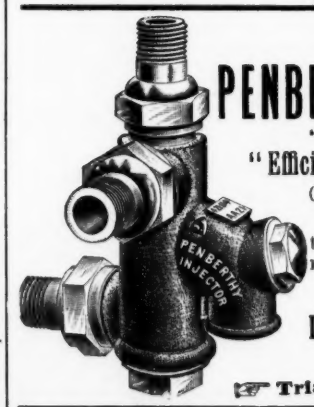


RUE M'F'G CO., PHILA., PA.

CATALOGUES FREE.

42,000 IN USE.

PENBERTHY AUTOMATIC INJECTOR.



"Phenomenal," "Efficiency 99 1-2 per cent." (*Michigan University.*)

"Excellent." "Efficacy 99.2 per cent." (*New Albany Laboratory.*)

RANGE 20 to 150 lbs. Lift 20 ft. Hot water supply, 115 to 128 deg. 80 lbs. pressure. One Valve to operate. Automatic and re-starting.

EASTERN DEPOT: DONEGAN & SWIFT, 11 Murray St., N. Y.

MANUFRS., PENBERTHY INJECTOR CO., DETROIT, MICH.

Trial, 30 Days. Return if not satisfactory.

PATENTS for inventions procured. Litigation, Searches, Opinions, &c. Trade Marks, Labels, &c., registered.

J. NOTA McGILL, Attorney-at-Law, ATLANTIC BUILDING, WASHINGTON, D. C.

FRISBIE FRICTION PULLEYS AND CLUTCHES.

THE D. FRISBIE CO.,

114 LIBERTY STREET, - NEW YORK.

3/8" **FLEXIBLE METALLIC FILLET**

FOR PATTERN MAKERS. 8 Sizes.

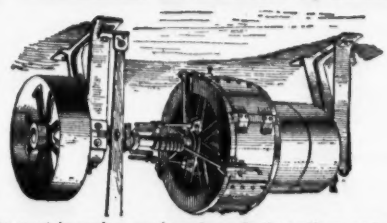
H. WHITE, 44 N. 4th Street, Phila., Pa.

ADRIANCE MACHINE WORKS

PRESSES, TOOLS, DIES & SPECIAL MACHINERY FOR SHEET-METAL, WIRE, PAPER & LEATHER.

PLYMOUTH & JAY STS. BROOKLYN, N.Y.

PERFECTLY UNIFORM SPEED!



The most irregular speed made perfectly uniform and regular. A change of over 30 per cent. can be obtained, while machine is in motion. Essential in all factories and mills and for driving dynamos. Makes power from water wheels, slow speed engines and electric motors absolutely regular and reliable.

Apply for information to

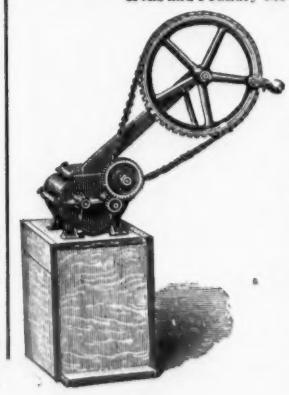
T. M. FOOTE REGULATOR CO.

Office: Exchange Building, Boston, Mass. Works at Ashland.

Western Agents: CHANDLER & LITTLEFIELD, Marine Bldg, Chicago, Ill.

ROOTS' NEW ACME HAND BLOWER.

For Blacksmiths, etc. Slow Speed, Positive Blast. Is Durable, Compact and Cheap; also Portable Forges, Tuyere Irons and Foundry Blowers.



P. H. & F. M. ROOTS, Mfrs.

CONNERSVILLE, IND.

S. S. TOWNSEND, Gen. Agt., 163 & 165 Washington St., NEW YORK.

COOKE & CO., Selling Agts.,

Please Mention This Paper.

Boilers for carrying 150lbs. Pressure

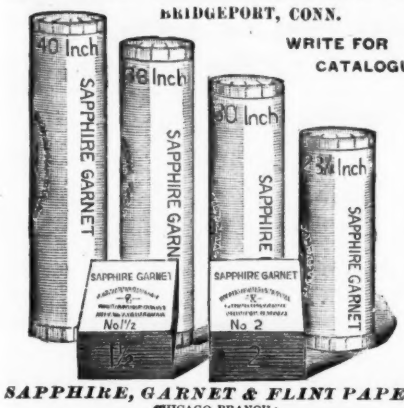
WITH LEAST POSSIBLE DANGER
AND HIGHEST ATTAINABLE ECONOMY

PROMPTLY FURNISHED BY

HARRISON SAFETY BOILER WORKS,
Germantown Junction, Philadelphia, Pa.

NEW YORK, N. Y. 41 Dey Street. CHICAGO, ILL. 187 LaSalle Street. ATLANTA, GA. 9 No. Pryor Street.

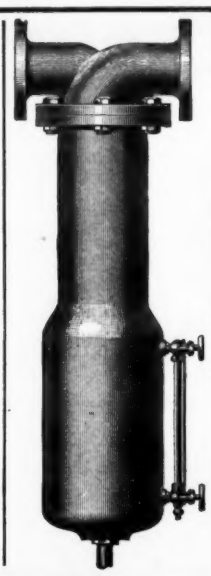
SPRINGFIELD EMERY WHEEL MFG. CO.,
SPRINGFIELD, CONN.



WRITE FOR CATALOGUE.

SAPPHIRE, GARNET & FLINT PAPER.
CHICAGO BRANCH
70 SOUTH CANAL STREET.

WHAT DO YOU WISH TO BUY?
We will furnish, without cost, Catalogues and Price-Lists of all the leading houses in the U. S. who deal in the article you want.
OSGOOD & WILLEY CO.,
POTTER BUILDING, NEW YORK CITY.



DRY STEAM
FURNISHED BY
THE POND SEPARATOR.

The Pond Separator is guaranteed to relieve the steam of all entrained water, and return this water to the Boiler, thus effecting a large saving in fuel.

Send for Circular.

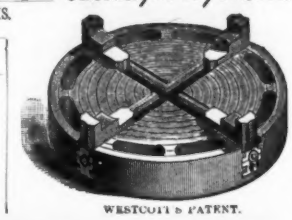
Pond Engineering Co.,
St. Louis, Kansas City, Dallas, Chicago, Omaha, Seattle.

Westcott Chuck Co., Formerly **Oneida Steam Engine & Foundry Co.,** **Oneida, N. Y., U. S. A.**

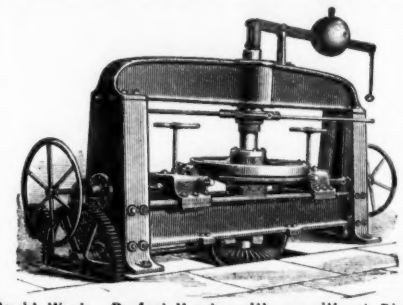
Manufacturers of all kinds of
LATHE AND DRILL CHUCKS
SEND FOR Illustrated Catalogue.

SCROLL COMBINATION LATHE CHUCKS.
BOTH 3 AND 4 JAW.

Diameter over all.	Will hold inside of Jaws.
4 9-16 in.	5 1-2 in.
6 in.	6 1-2 in.
7 1-2 in.	8 in.
10 1-8 in.	12 in.
13 1-4 in.	15 in.
16 in.	18 in.
18 1-2 in.	21 1-2 in.
21 1-4 in.	26 in.
24 in.	30 in.
30 in.	36 in.
36 in.	43 in.


WESTCOTT'S PATENT.

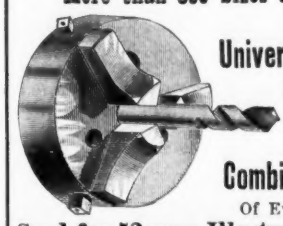
BOILER HEAD FLANGING MACHINE.



Rapid Work. Perfect Heads, with or without Dies. No Hole in Plate. Construction Simple. Price Reasonable.

JACOB CLARK, Mfr., Germantown, Philadelphia, Pa.

"THE HORTON LATHE CHUCK"
More than 300 Sizes and Styles.

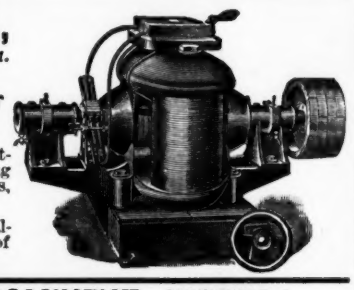


Comprising
Universal Chucks,
Independent Chucks,
Combination Chucks,
Of Every Description.

Send for 52 page Illustrated Catalogue.

The E. HORTON & SON CO.
Windsor Locks, Conn., U. S. A.
—OR—
CHAS. CHURCHILL & CO., Ltd.,
21 Cross Street, Finsbury, London, Eng.

THOS. H. DALLETT & CO.,
York St. & Sedgley Ave., Philadelphia.
Manufacturers of
Portable Drills, Hand Drills, Boiler Shell Drills, Light Drill Presses.
ELECTRIC MOTORS, Specially adapted for driving Machine Tools, Cranes, Elevators, Pumps, Presses and other Machinery.
ELECTRIC GENERATORS, For installation of Complete Power Plants.



INDEPENDENT 4 JAW LATHE CHUCKS WITH REVERSIBLE JAWS
SOLD BY ALL DEALERS
MORE CHUCKS OF THIS STYLE ARE USED FOR GENERAL MACHINIST'S WORK THAN ANY OTHER.
MADE IN 15 sizes from 4½ inch to 26 in. inclusive
FOR FURTHER PARTICULARS SEND FOR NEW DESCRIPTIVE CATALOGUE TO THE USHMAN CHUCK CO. HARTFORD, CONN.

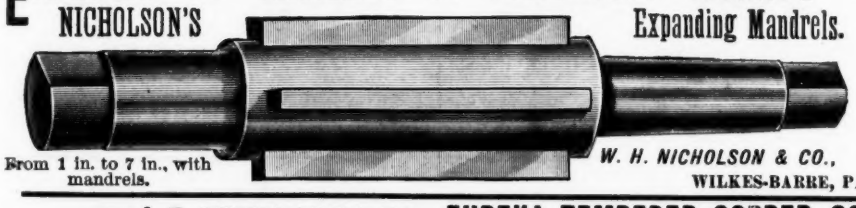
CHUCKS
Send for new Catalogue.
THE HOGGSON & PETTIS MFG. CO.,
Est. 1849. NEW HAVEN, CT.

PEQUOT DRILL CHUCK.

A new Drill Chuck having a more powerful grip than any chuck ever offered. This seems a broad claim, but we prove it to mechanics who will examine. Ask at your dealers or write us for particulars.

THE D. E. WHITON MACHINE CO.
No. 5 Oak St., New London, Conn.
S. A. SMITH, 23 S. Canal St. Chicago, Western Agt.

ENDORSED BY HUNDREDS OF PROMINENT WORKS!
NICHOLSON'S Expanding Mandrels.



From 1 in. to 7 in., with mandrels.

W. H. NICHOLSON & CO.,
WILKES-BARRE, PA.

TOOLS
SEND FOR CATALOGUE.

L. S. STARRETT
ATHOL, MASS., U. S. A.

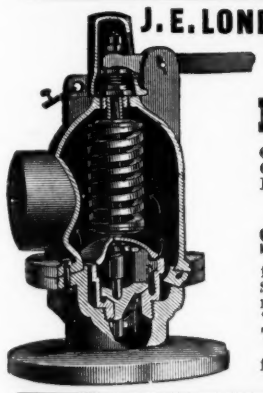
ALUMINUM
$1.50
PER POUND.
The Pittsburgh Reduction Co.
95 FIFTH AVENUE,
PITTSBURGH, PA.

Offer Aluminum, guaranteed to be equal in purity to the best in the market, at $1.50 per pound, in ingots. Aluminum sheet, wire and castings at lowest market prices. Correspondence solicited.

ALUMINUM POLISH, very efficacious and non-poisonous, suitable for household use as well as for manufacturing purposes.

ALUMINUM SOLDER.

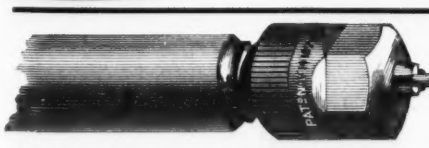
J. E. LONERGAN & CO.
211 Race St., Phila.
Manufacturers of
PATENT OILERS,
Cylinder Sight Feed Cups, Government Regulation
POP SAFETY VALVES
for Locomotive, Stationary and Marine Boilers, also the "Reliable" Steam Trap.
1888 Catalogue free on application.



EUREKA TEMPERED COPPER CO.
NORTH EAST, PA.
ONLY MANUFACTURERS OF
Pure Tempered Copper
FOR JOURNAL BEARINGS ELECTRIC COMMUTATORS, COMMUTATOR SEGMENTS, Brushes, Rolled Goods and Copper Castings.

MACHINISTS' SCALES,
PATENT END GRADUATION
We Invite Comparison for Accuracy with all others.
EVERY SCALE GUARANTEED. SEND FOR LIST.
COFFIN & LEICHTON, SYRACUSE, N. Y.

KEUFFEL & ESSER CO., NEW YORK.
Eclipse BLUE PRINT PAPER.
Eclipse IS THE CHEAPEST. NO WASTE. NO FAILURES.
Eclipse MAKES THE BEST AND MOST PERMANENT PRINTS.
Eclipse KEEPS LONGEST AND GIVES THE MOST PERMANENT PRINTS.
Eclipse WHEN WASHED AND DRIED IS STRONGER THAN IT WAS BEFORE.
IMITATIONS are plentiful. The principal advantage claimed for the imitations is the low price.
We claim that Eclipse is the cheapest, for the reasons stated above.
Samples, Price Lists and information cheerfully furnished. Photo Printing for the Trade.



TRUMP CHUCK.
The Cheapest and Best.
WILL HOLD ACCURATELY, STRAIGHT or TAPER Shank Drills.
Write for Prices to
TRUMP BROS. MACHINE CO., MFRS.
Wilmington, Delaware, U. S. A.
For Sale by CHAS. CHURCHILL & CO., Ltd.
21 Cross Street, Finsbury, London, England.

Made in 3 Sizes, viz.: No. 1. Holds 0 to ⅛″
" 2. " 0 to ¼″
" 3. " 0 to ⅜″

Bussell's Patent Interchangeable Lathe Tool
Time Saving. Easily Adjusted.

No Bolts or Screws.
For full information, address
S. W. REESE & CO., Sole Manufrs.,
182 FULTON STREET, NEW YORK.

ROSS ANTI-FRICTION BALL BEARING COLLAR.

A new Patent Application of Ball Bearing, patented Dec. 2, 1890, to Drill Presses, Lathe and all end thrust of Horizontal Shafts in Machinery. 95 per cent. of the friction overcome by this device. Full satisfaction guaranteed.

JOSIAH ROSS,
1443 to 1459 Niagara Street, Buffalo, N. Y.

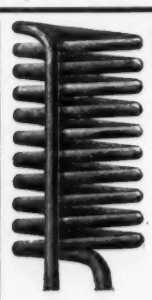
Special Milling Cutters, Reamers, Dies, Taps,
GEARS TO ORDER.
GEAR CUTTING TO ORDER up to 60 inch Diameter.

ADJUSTABLE BLADED REAMERS.
R. D. NUTTALL COMPANY, Allegheny, Pa.
Designers and Manufacturers of Special Machinery and Tools.

STEEL CASTINGS

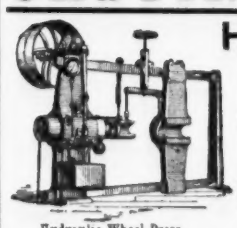
FROM 1-4 TO 15,000 LBS. WEIGHT.
True to pattern, sound, solid, free from blow-holes and of unequaled strength.
Stronger and more durable than iron forgings in any position or for any service whatever.
60,000 CRANK SHAFTS and 50,000 GEAR WHEELS of this steel now running prove this.
Crossheads, Rockers, Piston-Heads, etc., for Locomotives.
STEEL CASTINGS of every description.
Send for Circulars and prices to
CHESTER STEEL CASTINGS CO.,
Works, Chester, Pa. Office 407 Library St., Philadelphia, Pa.

DIXON'S INDIA SILVER LEAD
FOR SMOOTH CASTINGS
COAT THE SURFACE OF MOULDS AND GATES.
JOSEPH DIXON CRUCIBLE CO.,
Manufacturers Pencils & Graphite Specialties,
JERSEY CITY, N. J.

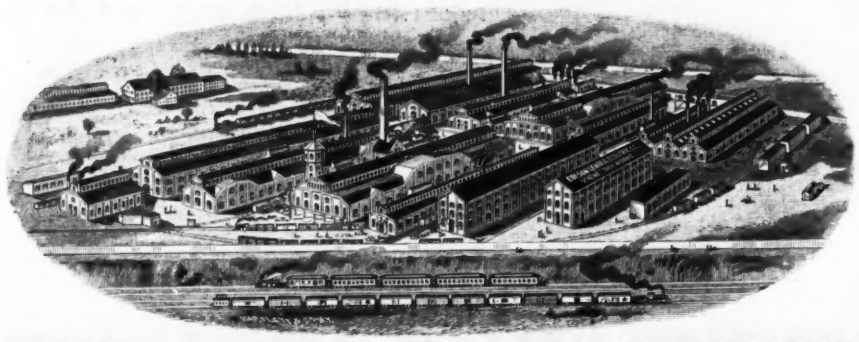


COILS & BENDS
—OF—
IRON,
BRASS and COPPER
PIPE.
ALL STYLES.
THE NATIONAL PIPE BENDING CO.,
82 River Street, NEW HAVEN, CONN.

HYDRAULIC MACHINERY
PRESSES, PUMPS, PUNCHES,
JACKS, VALVES, FITTINGS, PACKINGS,
ACCUMULATORS.
WATSON & STILLMAN, MFRS.
204, 206, 208 & 210 E. 43d St., New York.


Hydraulic Wheel Press.

Vertical Check Valve.



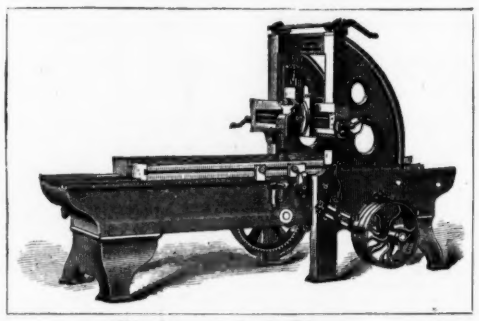
EDISON GENERAL ELECTRIC COMPANY,

COMPLETE STOCK OF
DOUBLE BRACE, SELF-OILING, ADJUSTABLE BALL AND SOCKET HANGERS, PILLOW BLOCKS, POST HANGERS, ETC.
THE EDISON PATENT COMPRESSION COUPLING.
We are in a position to fill all Orders Immediately.
Address EDISON GENERAL ELECTRIC CO., Schenectady, N. Y.

HILL, CLARKE & CO.

156 Oliver Street, Boston, Mass.

Engine Lathes,
Metal Planers,
Upright Drills,
Shapers,
Milling Machines,
Screw Machines,
Gear Cutting Machines,
Boring Mills,
Chucking Lathes,

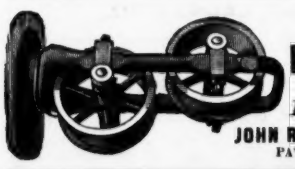


Flather 26 Inch Planer.

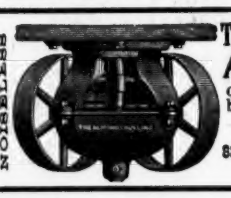
Pattern Makers' Lathes,
Pattern Makers' Saw Tables,
Jig Saws,
Buzz Planers,
Steam Hammers,
Helve Hammers,
Bolt Cutters,
Bolt Headers,
Nut Tappers

Machinery and Machine Supplies,

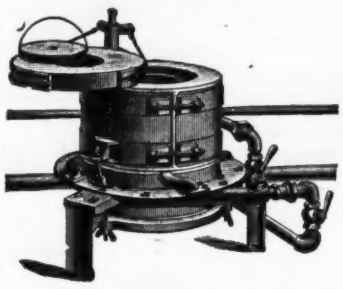
FOR MACHINE, PATTERN AND BLACKSMITH SHOPS.



GUIDE PULLEYS
FOR *Light Belts.*
JOHN ROYLE & SONS,
PATERSON, N. J.



The Almond Coupling
A NEW quarter turn motion to replace quarter turn belts and bevel gears.
T. R. ALMOND, MFR.,
63 and 65 Washington Street,
BROOKLYN, N. Y.



AMERICAN GAS FURNACE CO.,

DESIGNERS AND MANUFACTURERS

GAS BLAST FURNACES.

Send for Catalogue. Estimates made for any mechanical operation requiring **high, even** and **controllable temperature.**

No. 80 NASSAU ST.,
NEW YORK.

A. R. KING MFG. CO.,

ERIE, 11th and 12th Streets, JERSEY CITY, N. J.

HEAVY AND LIGHT **CASTINGS** IRON OR BRASS.

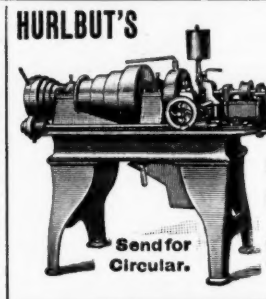
MFRS OF BOILER MAKERS' TOOLS, SCREW PUNCHES, TUBE EXPANDERS, PACKER RATCHETS, TUBE CUTTERS, ETC.

GENERAL MACHINE WORK. Write for CATALOGUE. CORRESPONDENCE INVITED.

Established 1845.
BUILD and REPAIR YOUR MACHINERY BY USING
MACHINE TOOLS
Manufactured by
LATHE & MORSE TOOL CO.,
Worcester, Mass., U. S. A.

SEND FOR CATALOGUE D.

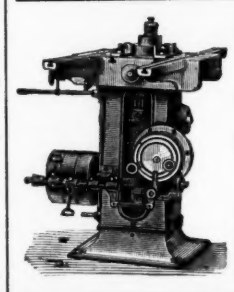
HURLBUT'S



Patent Cutting-off and Centering Machine.
Sizes 2", 3", 4", 5", 6".
MADE BY
Hurlbut & Rogers,
South Sudbury, Mass.
Send for Circular.
Chas. Churchill & Co., Ltd, Agents, 21 Cross St., London, England.

BELLOWS
Beam Micrometer

Send for CATALOGUE to
STANDARD TOOL CO., Athol, Mass.



KEY SEATERS
Portable and Stationary.
Back-Cutting Attachment Key-Making Machines.
Giant Key-Seater Co.
EAST SAGINAW, MICH.
April 25, 1891. We are very much pleased with it, and think it the best machine on market for simplicity and effective work. DAVIS & COWGILL IRON WORKS, Omaha, Neb.

American Standard Gauge & Tool Works
WILMINGTON, DEL.
Makers of Implements for Standard Measurements.

Over 48,000 in Use.
Crescent Gauge.
Flat Bar Gauge.
JAS. A. TAYLOR & CO.

HUGO BILGRAM,
440 N. 12th St., Phila., Pa.
Maker of all kinds of
MACHINERY.
Special facilities for Accurate Work.
Bevel Gears cut theoretically Correct.

IMPROVED IRON PLANERS.

24 inch, 32 inch, and 36 inch Wide.

DESIGNED FOR EXTRA HEAVY DUTY.

ENGINE LATHES,
TURRET LATHES,
PULLEY LATHES,
CHUCKING LATHES,

IRON PLANERS,
IRON SHAPERS,
MILLING MACHINES,
SCREW MACHINES,

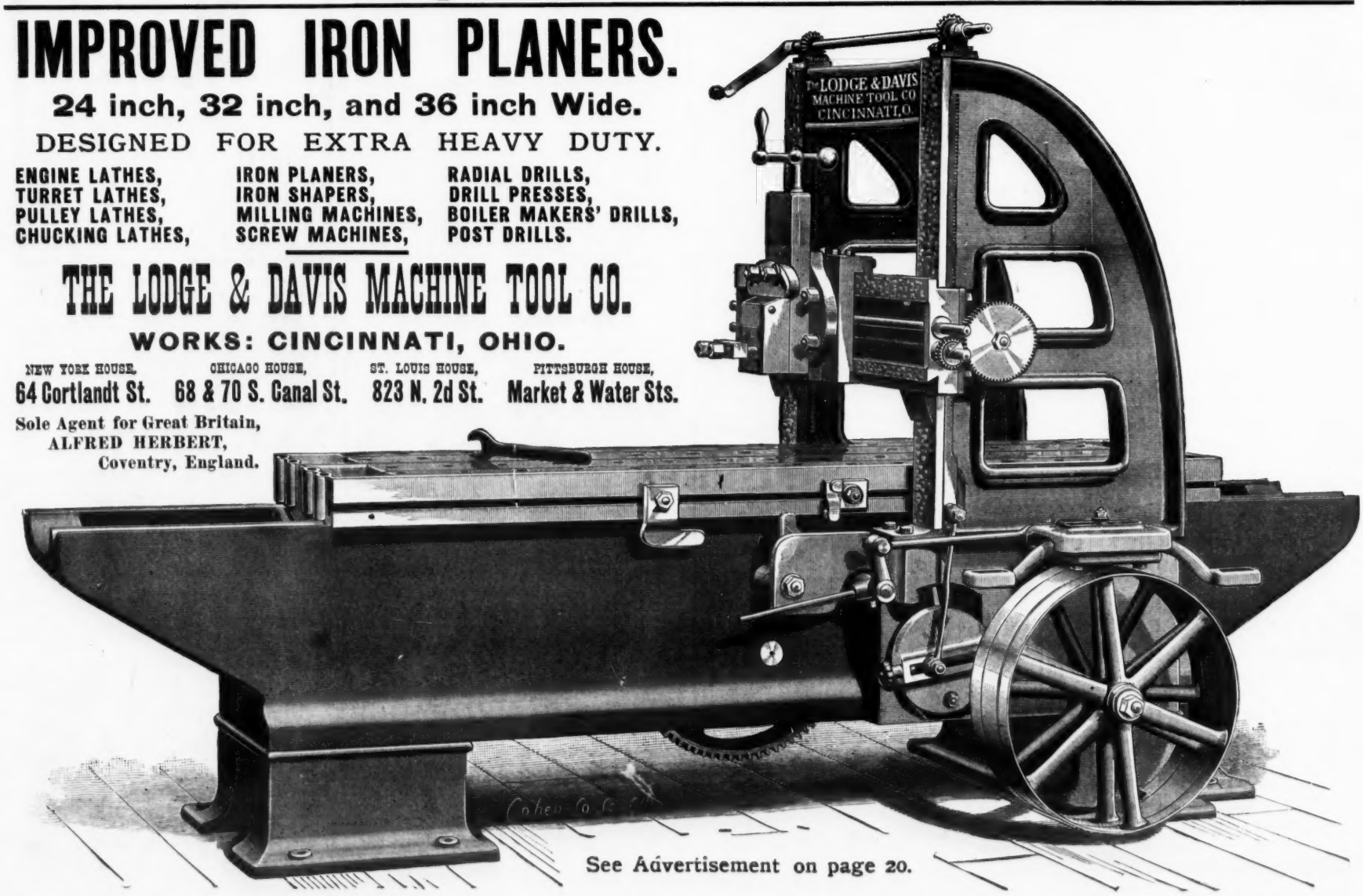
RADIAL DRILLS,
DRILL PRESSES,
BOILER MAKERS' DRILLS,
POST DRILLS.

THE LODGE & DAVIS MACHINE TOOL CO.

WORKS: CINCINNATI, OHIO.

NEW YORK HOUSE, 64 Cortlandt St.
CHICAGO HOUSE, 68 & 70 S. Canal St.
ST. LOUIS HOUSE, 823 N. 2d St.
PITTSBURGH HOUSE, Market & Water Sts.

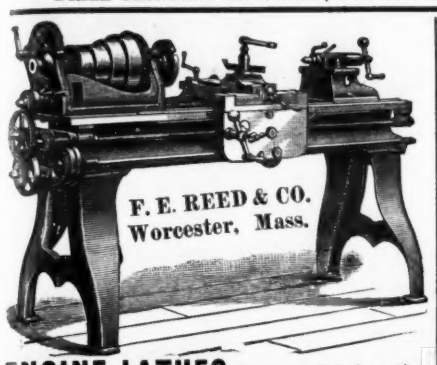
Sole Agent for Great Britain,
ALFRED HERBERT,
Coventry, England.



See Advertisement on page 20.

MORSE TWIST DRILL AND MACHINE COMPANY,
Manufacturers of Morse Patent Straight-Lip Increase Twist Drills. New Bedford, MASS.

Solid and Shell Reamers, Beach's Patent Self-Centering Chuck, Bit Stock Drills.
DRILL GRINDING MACHINES, MILLING CUTTERS AND SPECIAL TOOLS TO ORDER.



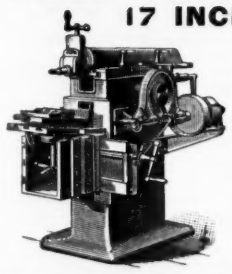
ENGINE LATHES from 10 to 30 inches swing.
Also Hand Lathes, Foot Lathes and Milling Machines.

FLATHER ENGINE LATHES.
14, 15, 16, 18, 20, 24 and 28 INCH SWING.
ANY LENGTH OF BED DESIRED.
HILL, CLARKE & CO.,
General Selling Agents,
156 OLIVER ST., BOSTON, MASS.

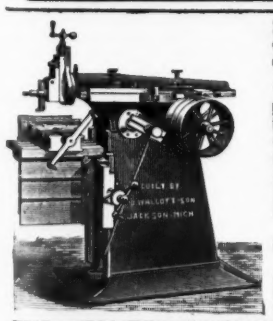
PRENTICE BROS.,
Manufacturers of
Lathes & Upright Drills.
Lathes from 10 in. to 20 in. swing. Largest Variety of Drills manufactured in the world.
Worcester, Mass.

☞ IMMEDIATE DELIVERY.
15" and 18" Crank
20" and 26" Geared } **SHAPERS.**
JNO. STEPTOE & CO., Cincinnati, Ohio.

PATENT FRICTION SHAPER.
17 INCH STROKE.



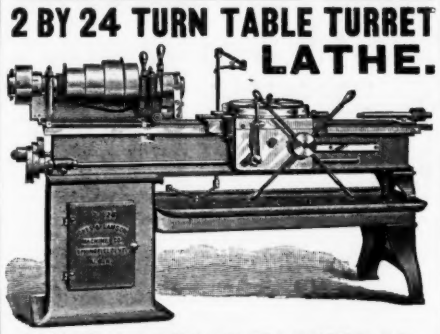
Double racks allowing shaft 2¾ to pass through base. Adjustable table for taper work, swivel jaw vise, feed adjustable while running, driven by hardened steel worm in phosphor bronze wheel.
Weight, 1300 lbs.
Write for Prices.
J. D. Wright & Sons,
69 & 71 GEORGE ST., BROOKLYN, E. D., N. Y.



GEO. D. WALCOTT & SON
Manufacturers of
LATHES AND SHAPERS
JACKSON, MICH.
WRITE US for PHOTO & PRICES

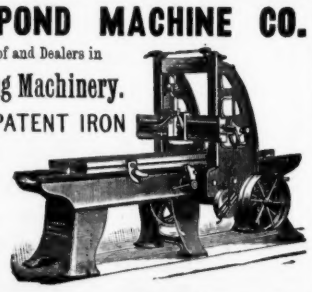
New Haven Manf'g Co.,
NEW HAVEN, CONN.
IRON-WORKING MACHINERY.

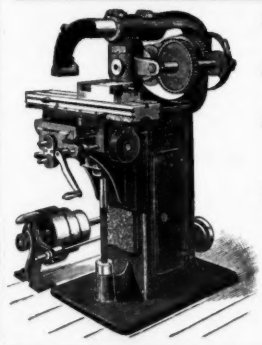
2 BY 24 TURN TABLE TURRET LATHE.



JONES & LAMSON MACHINE CO.,
Springfield, Vt., U. S. A.

L. W. POND MACHINE CO.
Manufacturers of and Dealers in
Iron Working Machinery.
IMPROVED PATENT IRON PLANERS A SPECIALTY.
152 Union St.,
WORCESTER, MASS.

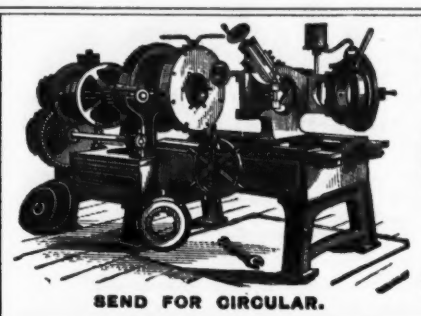




Complete Universal Milling Machines.
Plain Back Geared Milling Machines.
Plain Universal Heads.
All designed to meet the requirements of the best practice.
KEMPSMITH Machine Tool Co.,
MILWAUKEE, WIS.

GAGE MACHINE WORKS,

MANUFACTURERS OF
MACHINE TOOLS,
WATERFORD, N. Y.



SEND FOR CIRCULAR.

D. SAUNDERS' SONS,
Manufacturers of
Pipe Cutting & Threading Machines
For Pipe, Mill and Steam Fitters' Use.
TAPPING MACHINES,
For Steam Fitting, also
Steam and Gas Fitters' Hand Tools.
21 Atherton St., Yonkers, N. Y.

SHARP TOOLS—GOOD WORK.

CHAS. CHURCHILL & CO., Ltd., AGENTS, 21 Cross St., London, Eng.

THIS
Universal Cutter
AND
Reamer Grinder
will grind all kinds of cutters and reamers up to 8" diam. without the use of special attachments.
Simple, Accurate, Rapid.
Price, $150.
Write for Catalogue.
ADDRESS
THE
Cincinnati Milling Machine Co.,
CINCINNATI, O.

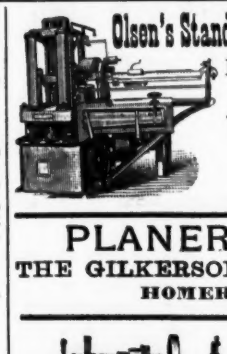
Established 1850.
DEFIANCE MACHINE WORKS,
DEFIANCE, OHIO U. S. A.
BUILDERS OF
Wood Working Machinery
FOR
HUB, SPOKE, WHEEL, WAGON, CARRIAGE, BENDING, & BARREL-HOOP FACTORIES.
Catalogues Free.

Wheel Boring Machine.

BOYNTON & PLUMMER,
WORCESTER, MASS.
Manufacturers of
Shaping Machines, Drilling Machines, Bolt Cutting Machines.
CHAS. CHURCHILL & CO., Ltd, Agents, 21 Cross St., Finsbury, London, England.

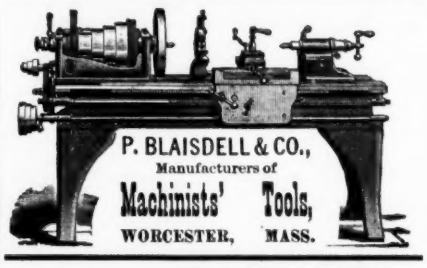
STOP THAT NOISE
USE THE NOISELESS PATENT.
TRADE MARK
RAW HIDE GEAR
COMPLETE IN ITSELF
MANUFACTURED BY THE NEW PROCESS RAW HIDE CO.
SYRACUSE, N.Y.

STRICTLY NOISELESS AND MORE DURABLE THAN STEEL.
Patentees and Sole Manufacturers
THE NEW PROCESS RAW HIDE CO.,
SYRACUSE, N. Y., U. S. A.



Olsen's Standard Testing Machines,
Hydraulic Machinery a Specialty.
TINIUS OLSEN & CO.,
MFRS.,
12th & Buttonwood Sts.,
PHILADELPHIA, PA.

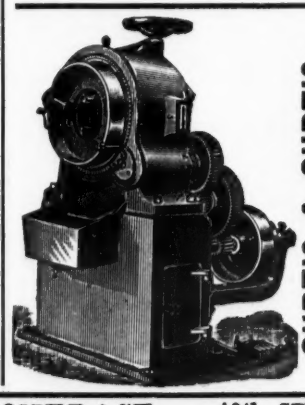
PLANER VISES.
THE GILKERSON MACHINE CO.,
HOMER, N. Y.



BARNES' UPRIGHT DRILLS
Complete line, ranging from our New Friction Disk Drill, for light work to 42-inch Back Geared, Self Feed Drill.
Send for Catalogue and Prices.
W. F. & JOHN BARNES CO.,
1995 Ruby Street, Rockford, Ill.

Price $8
NO GAUGES.
NO BELT.
Every Machine Guaranteed.

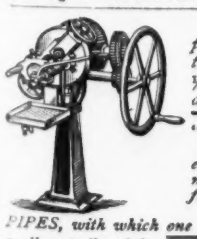
BARKER'S IMPROVED **CENTER GRINDING MACHINE.**
Manufactured by
WM. BARKER & CO.
CINCINNATI, O.
SEND FOR CIRCULAR.



CURTIS & CURTIS,
66 GARDEN ST., BRIDGEPORT, CONN.
Pipe Cutting & Threading Machinery,
FOR HAND OR POWER.
RATCHET DRILLS, RATCHET DIE STOCKS AND MALLEABLE IRON PIPE VISES.

NEW SHOP. AMPLE ROOM.
PERFECT EQUIPMENT. PERFECT LIGHT.
NO MAKESHIFTS. EASILY REACHED.
W. D. FORBES & CO., HOBOKEN, N. J.
FINE TOOL AND MACHINE WORK.
CONTRACT, JOB, OR DAYS' WORK.
13th STREET, AND HUDSON, HOBOKEN.

"Eclipse" Hand Pipe-Cutting Machines

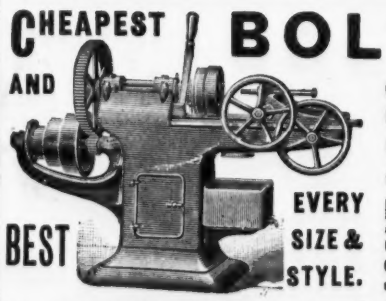


No. 1.—Powerful, inexpensive, simple in construction. Cuts and screws pipes ¼ to 2-inch. Easily carried about.

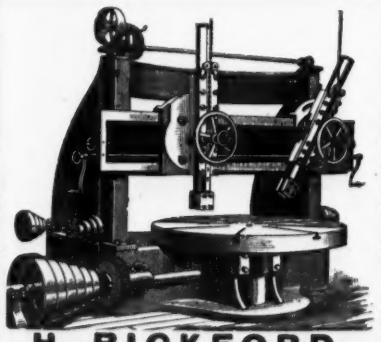
"ECLIPSE" Nos. 2 and 3. These are powerful and most efficient machines for cutting large PIPES, with which one man can easily cut off and thread 6-inch pipe.
No. 2 Cuts and Screws 2½ to 4 in.
No. 3 " " " 2½ to 6 in.
It will pay you to write us for particulars.

PANCOAST & MAULE,
(Mention this paper.) *Philadelphia.*
☞ *We also build Power Machines*

CHEAPEST AND BEST **BOLT CUTTERS.** EVERY SIZE & STYLE.



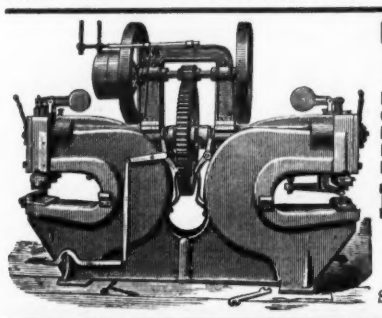
H. B. BROWN & CO.,
EAST HAMPTON, CT.



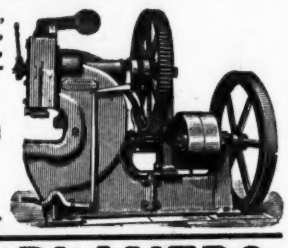
H. BICKFORD,
LAKE VILLAGE, N. H.
BORING AND TURNING MILLS, 4, 5 and 6 Ft. SWING.

Engineers Who Write
The MASON REGULATOR CO.,
of Boston, are never disappointed. "Advice is cheap." Therefore it is sent in the form of a descriptive catalogue.

WILLIAM SELLERS & CO., Incorporated.
PHILADELPHIA, PA.
BUILDERS OF
MACHINE TOOLS FOR WORKING IRON AND STEEL
Improved TURNTABLES for LOCOMOTIVES, CARS and PIVOT BRIDGES.
High Speed Power Traveling Cranes and Hand or Power Swing Cranes, Shafting, Pulleys, Hangers, &c., for transmission of power. Improved Self-Adjusting Injector of 1876. Self-Acting Injector of 1887. Fixed-Nozzle Automatic Injector of 1885.
INJECTORS for ALL CONDITIONS of LOCOMOTIVE and STATIONARY SERVICE.

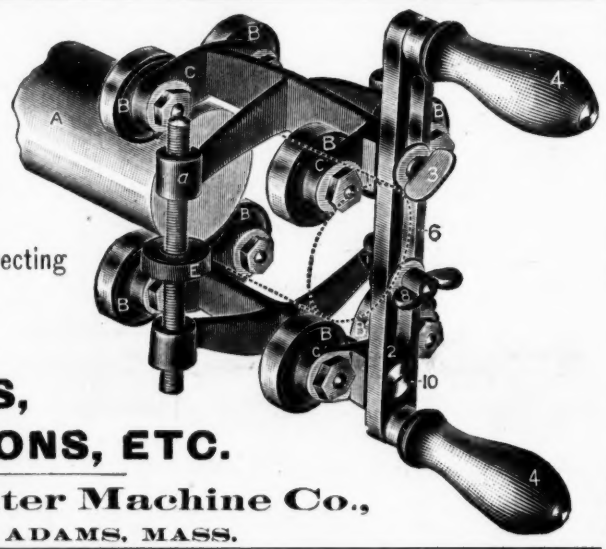


THE LONG & ALLSTATTER CO. Hamilton, OHIO.
Double, Single, Angle-Bar, Gang, Horizontal, Twin, Boiler, Spacing, Gate, Multiple, Belt and Steam-Driven
Punches and Shears,
OVER 300 SIZES.
ALSO
Power Cushioned Hammer.
Send for New Catalogue.



THE OPEN SIDE IRON PLANERS.
GUARANTEED
Equal to any Planer of the ordinary style in the performance of standard size work and in
EFFICIENCY, CAPACITY, AND ADAPTABILITY TO EXCEL
ANY OTHER METAL PLANING TOOL.
Sizes 30″ to 120″ by any length. Write for prices and detailed information.
DETRICK & HARVEY MACHINE CO., Manufacturers, BALTIMORE, MD.

NEW PATENT
CENTER RHYMER
For Finding and Correcting the Center of
SHAFTS, SPINDLES, GUDGEONS, ETC.



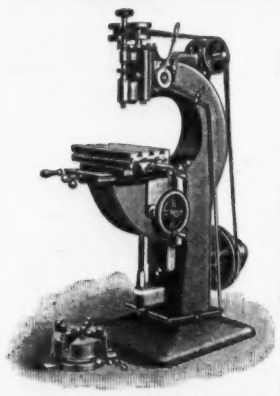
James Hunter Machine Co.,
NORTH ADAMS, MASS.

20-INCH, 25-INCH AND 30-INCH SWING
TURRET CHUCKING LATHES
The Universal Radial Drill Co.
CINCINNATI, OHIO, U. S. A.

PRESSES, DIES AND OTHER
SHEET-METAL TOOLS
FERRACUTE MACHINE CO. BRIDGETON, N. JERSEY, U.S.A.

Pat. KEY-SEAT or SPLINING GAUGE
PATENT UNIVERSAL SCREW-CUTTING CENTER DEPTH ANGLE AND
J. WYKE & CO., TWIST DRILL GAUGE.
Fine Machinists' Tools.—E. Boston. Mass.—Send for Circular

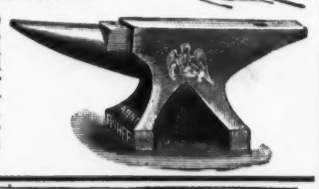
THE BECKER VERTICAL MILLER
No. 2.



For High Speed Milling.
An indispensable Tool in any well appointed machine shop.
Speeds from 240 to 10,000 revs.
Send for Circular.
MANUFACTURED BY
JOHN BECKER MANF'G CO.,
157 PEARL ST., BOSTON.

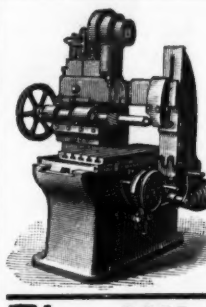
EAGLE ANVIL WORKS,
Trenton, N. J.

The Fisher Double Screw Leg Vise.—Warranted stronger grip than any other Vise. Always parallel and cannot be broken.
Send for Circulars.



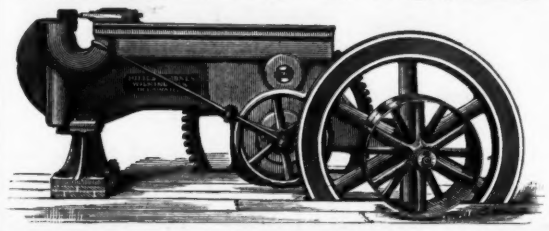
The Eagle Anvil.—Best Cast Steel Face & Steel Horn. Better than any English anvil. Fully warranted and lower price.

LIGHT DRILL PRESSES
M.F.R.S. OF
THE LARGEST VARIETY
SEND FOR NEW 80 PAGE CATALOGUE JUST OUT
DWIGHT SLATE MACHINE CO.
HARTFORD, CONN.



BEMENT, MILES & CO.,
PHILADELPHIA, PA.
—BUILDERS OF—
METAL-WORKING MACHINE TOOLS
FOR
Railroad Shops, Locomotive and Car Builders, Machine Shops Rolling Mills, Steam Forges, Ship Yards, Boiler Shops, Bridge Works, Etc., Etc.

The HILLES & JONES CO., WILMINGTON, DELAWARE,



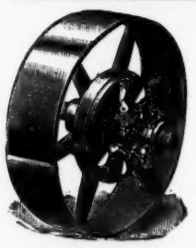
MANUFACTURERS OF
MACHINE TOOLS,
FOR
BOILER MAKERS, BRIDGE BUILDERS, SHIP BUILDERS, RAILROAD SHOPS, LOCOMOTIVE AND CAR BUILDERS, ETC., ETC.
HORIZONTAL FLANGE PUNCHES, ALL SIZES.

WYMAN & GORDON,
WORCESTER, MASS.

DROP FORGINGS.

ACME MACHINERY CO.
CLEVELAND, OHIO.
Manufacturers of
ACME BOLT & RIVET HEADERS,
Acme Single & Double Automatic BOLT CUTTERS.
Cutting from 1-8 in. to 6 in. diameter.
Also SEPARATE HEADS and DIES.
FIRST PREMIUM, CINCINNATI CENTENNIAL.

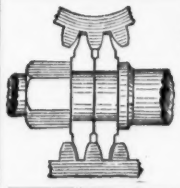
PAT. DEC. 5, 1882.
PAT. DEC. 4, 1883.
PAT. AUG. 25, 1885.



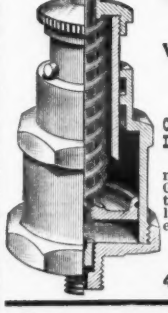
The Moore & White Co.,
15th St. & Lehigh Ave.
PHILADELPHIA, PA.
MFRS. OF
The "Moore & White"
Friction Clutches
AND
Cut-Off Couplings.
Send for Circulars.

RADIAL DRILLS
For Machine Shop Use.
Special Radials for Bridge Builders.
Box's Double Screw Hoist,
500 lbs. to 20 Tons Capacity carried in Stock.
Full line of Cranes usually in course of erection, from the small single track and trolley to 50-ton Traveling and Jib Cranes.
Photos and Cuts on Application.

Alfred Box & Co.,
Front, Poplar & Canal Sts.,
Philadelphia, Pa.



CLOUGH'S PATENT DUPLEX GEAR CUTTER
One pair of these Cutters cuts a pitch of interchangeable gear wheels from 15 teeth to a rack inclusive.
For circular and prices, address
R. M. CLOUGH,
TOLLAND, CONN.

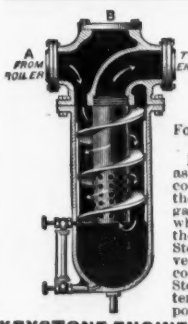


LACKAWANNA GREASE CUP
Will Save its Cost in Oil alone Several Times per Annum.
SAVES ALSO IN LABOR AND COST OF COTTON-WASTE, PREVENTS DRIPPING AND SPATTERING.
A POSITIVE FORCE FEED with the most PERFECT REGULATION and GREATEST CONVENIENCE in operation yet attained in any device for the lubrication of machinery. Works equally well in every possible position.
Lackawanna Lubricating Co.,
41 Coal Exchange, Scranton, Pa.

ABSOLUTELY DRY STEAM
CAN BE SECURED BY USING
Straight Line Centrifugal Separator.

In use on steam mains 200 to 800 feet in length. Also on Old Colony, Stonington, Ward's, Lehigh Valley Towing and other steamer lines.
Send for Circulars to
JOSEPH DE RYCKE,
145 Broadway & 86 Liberty St.,
NEW YORK.

OUR NEW **CATALOGUE OF TOOLS**
And Supplies sent free to any address on receipt of Ten Cents in Stamps (for postage).
Chas. A. Strelinger & Co., WOOD AVE. **Detroit, Mich.**



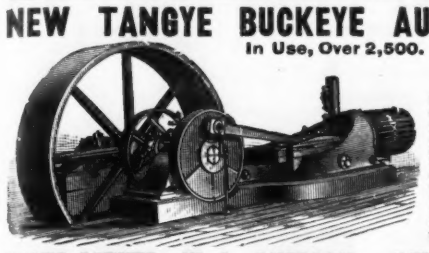
DRY STEAM.
Simpson's Centrifugal Separator and Trap.
For Supplying Clean and Dry Steam to Engines, Dry Houses, etc.
Place Separator as close to engine as possible, the steam taking a spiral course between the threads causes the water to be thrown by centrifugal force against the outer walls, while the dry steam goes through the small holes to center of pipe. Steam can enter at A or B, as convenience may require; also used in conveying steam long distances, for Steam Hammers, Dry Houses, Water Gas Generators, and for all purposes where Dry Steam is necessary.
KEYSTONE ENGINE AND MACHINE WORKS,
Fifth and Buttonwood Streets, Philadelphia,
Or, A. T. ARTHUR, Selling Agent, 18 Cortlandt St., N. Y.

CHEAPEST AND BEST
THE WATER-TUBE FEED-WATER HEATER
SEND FOR CATALOGUE

THE GOUBERT MFG. CO.
32 CORTLANDT ST. NEW YORK.

NEW TANGYE BUCKEYE AUTOMATIC CUT-OFF ENGINES

In Use, Over 2,500. 25 to 1,000 H. P.



These engines are the combined result of long experience with automatic cut-off regulation, and most careful revision of all details. They are designed and constructed for heavy and continuous duty at medium or high rotative speeds. Highest attainable Economy in Steam Consumption and superior regulation guaranteed. Self-contained Automatic Cut-off Engines 12 to 100 H. P. for Driving Dynamo Machines *a specialty*. Illustrated Circulars, with various data as to practical Steam Engine Construction and performance, free by mail. Address, BUCKEYE ENGINE CO., Salem, Ohio.

SALES AGENTS: W. L. SIMPSON, 10 TELEPHONE BUILDING, } N. W. ROBINSON, 154 Washington St., Chicago, Ill.
18 CORTLANDT STREET, N. Y. } ROBINSON & CARY COMPANY, St Paul, Minn.

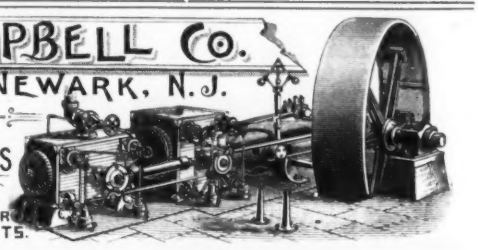
KENSINGTON ENGINE WORKS, LIMITED, PHILADELPHIA.

Sole Licensees and Manufacturers for New Jersey (South of Trenton), Eastern Pennsylvania, Delaware, Maryland, and Virginia

THE WATTS, CAMPBELL CO.

MANUFACTURERS OF IMPROVED CORLISS STEAM ENGINES IN FULL VARIETY.

NEWARK, N. J.



CONTRACTS TAKEN FOR COMPLETE POWER PLANTS.

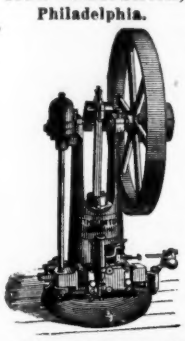
"OTTO" GAS ENGINE WORKS.

SCHLEICHER, SCHUMM & CO.,

23d & Walnut Streets, Philadelphia. 151 Monroe Street, Chicago.

New York Agency, 18 Vesey St.

35,000 SOLD.



Many New Improvements FOR USE WITH

COAL GAS, NATURAL GAS, PRODUCER GAS, OR GASOLINE.

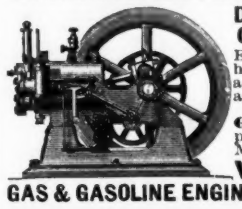
COMBINED

"OTTO" GAS ENGINES AND PUMPS.

Consume 25 to 75 Per Cent. Less Gas than ANY other Gas Engine doing the same work.

GAS and GASOLINE ENGINES

STATIONARY and PORTABLE. All Sizes.



Dwarfs in Size, but Giants in Strength.

Expense one cent an hour per horse power and requires but little attention to run them. **Every Engine Guaranteed.** Full particulars free by mail Mention this paper.

VAN DUZEN GAS & GASOLINE ENGINE CO. Cincinnati, O.

Eclipse Corliss Engine.

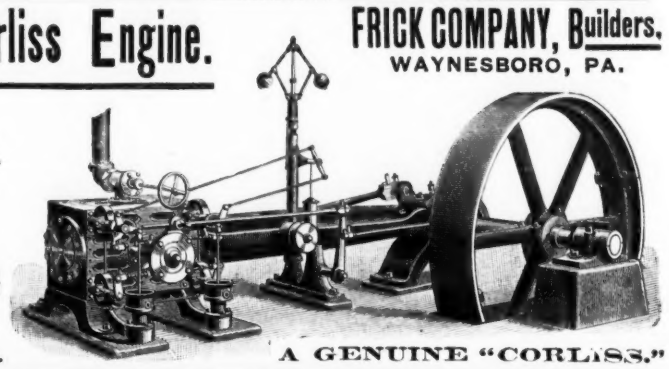
FRICK COMPANY, Builders. WAYNESBORO, PA.

NON-CONDENSING, CONDENSING COMPOUND. 40 TO 1,000 H.P.

Send for Circulars.

ICE-MAKING AND REFRIGERATING MACHINERY.

Send for Special Circular.



A GENUINE "CORLISS."

THE IXL DRAWING STAND

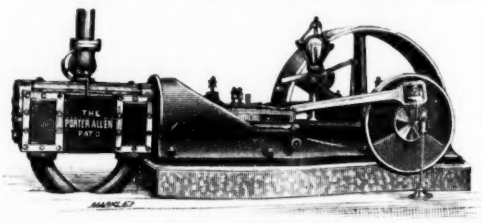
PATENTED.

With or without board.

The best and most convenient Drawing Table in the world.

JONES & MACK, Smith Bldg, 220 Walnut St., CINCINNATI, O.

SOUTHWARK FOUNDRY & MACHINE CO., PHILADELPHIA, PA.

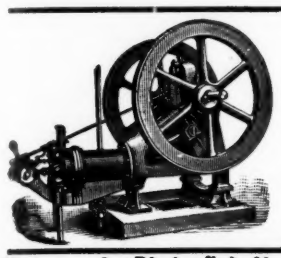


SOLE MAKERS OF THE PORTER-ALLEN AUTOMATIC ENGINE.

ALSO BUILDERS OF

Blowing Engines. Reversing Engines. Hydraulic Cranes. Centrifugal Pumps, Accumulators, Boilers, Tanks, etc.

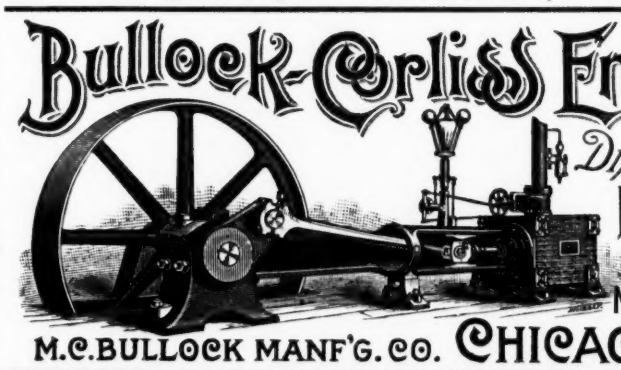
ATKINSON CYCLE GAS ENGINE.



Four strokes of piston in one revolution of crank-shaft, expanding the charge to more than the original volume, driving out *all* the products of combustion, and giving a working stroke at every revolution and in half the time required by any other engine. *Send for Illustrated Circular*

HENRY WARDEN, MANUFACTURER, 1810 ALLEGHENY AVENUE, PHILADELPHIA, PA.

Bullock-Corliss Engines.



DIAMOND DRILLS FOR PROSPECTING

BAND FRICTION HOISTS,

MINING MACHINERY

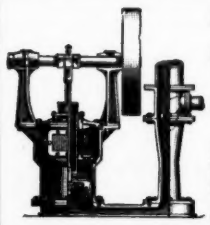
M. C. BULLOCK MANF'G. CO. CHICAGO, U. S. A.

Universal and Plain Grinding Machines,

4 SIZES.

Work and traverse instantly varied to any speed between extremes. Reversingpoints varied by hand. Pivoted table simultaneously clamped at both ends by hand, has no slot or screws on its end; easy to keep clean; is graduated in ¼ degrees and in taper in inches per foot.

LANDIS BROS. Manufacturers, Waynesboro, Pa.



Belt Power Air Pump and Condenser.

The CONOVER MFG. CO., CONSULTING AND MECHANICAL ENGINEERS 95 LIBERTY STREET, NEW YORK.

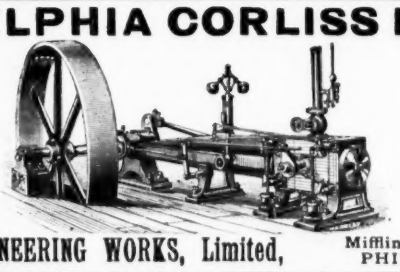
No Air Locks. 15 to 50 per cent. fuel saved or equal amount of power gained. Runs with same economy as engine. Adapted to all kinds of Engines. *Send for Circular.*

PHILADELPHIA CORLISS ENGINES

NON-CONDENSING. CONDENSING.

Triple and Quadruple Expansion.

Horizontal or Vertical. Superior Design, Workmanship and Finish.



BEST MATERIAL. HIGHEST EFFICIENCY GUARANTEED.

Catalogues Mailed on Application.

PHILADELPHIA ENGINEERING WORKS, Limited, Mifflin and Meadow Streets, PHILADELPHIA, PA.

W. C. YOUNG & CO., Worcester, Mass.

Manufacturers of *Engine Lathes, Hand Lathes,* FOOT POWER LATHES, SLIDE RESTS, ETC.

MACHINE TOOLS IN STOCK.

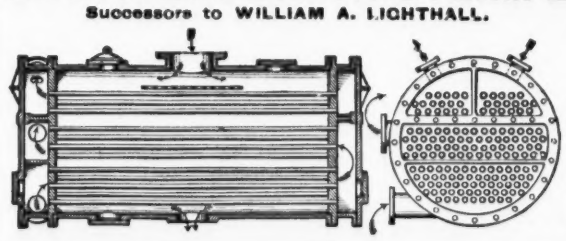
Engine Lathe,	13 in.x6 ft.,	Ames Mfg. Co
" "	12 in.x6 ft.,	Prentice Bros
" "	15 in.x6 ft.,	" "
" "	18 in.x8 ft.,	" "
" "	14 in.x6 ft.,	Fitchburg, Plain & Taper
" "	16 in.x6-8 ft.,	" " "
" "	18 in.x8 ft.,	" "
" "	24 in.x12 ft.,	" "
" "	14 in.x6 ft.,	Hendey, Plain & Taper
" "	16 in.x6 ft.,	" "
" "	18 in.x6-8-10 ft.,	" Plain & Taper
" "	20 in.x10 ft.,	D. W. Pond, good order
" "	20 in.x8-10-14 ft.,	Standard Pattern
" "	24 in.x12-14 ft.,	" "
" "	28 in.x12-16 ft.,	" "
" "	32 in.x18 ft.,	" "
" "	92 in.x18 ft.,	Triple Gd, good order, price low
Upright Boring and Turning Mill, 39 in. swing.		
Planer,	34 in.x6 ft.,	Powell Planer Co
"	30 in.x10 ft.,	" " "
"	36 in.x12 ft.,	" " "
"	24 in.x5 ft.,	Walters, 2d hand
"	30 in.x8 ft.,	Fitchburg "
"	48 in.x11 ft.,	Burns & Co "
"	24 in.x6 ft.,	Fitchburg, new pattern
"	24 in.x6 ft.,	Lathe & Morse
Drill, Sensitive,		Slate Mch. Co., 2d hand
" "	1-3-4 spindles,	" " "
"	3 spindle,	2nd hand, good order
"	20 in. swing,	Prentice Bros
"	25-28-32 in. complete,	" "
Radial Drill, 3 ft. arm, new pattern.		
Shaper,	14 in. Trav. Head,	Fitchburg
"	15-24-30 in. Crank Motion, new pattern	
"	24 in. Friction,	Hendey
Milling Machines, Universal Improved Pattern.		
" "	Lincoln pattern,	Garvin 2d hand
Screw Machine,	Brown & Sharpe, wire feed, 2d hand	
" "	Niles Tool Works, 1 7-8 in. hole, with feeds and large assortment of tools, good order	
Brass Lathes, Fox, Monitors, all sizes.		
Pipe Machine, cuts 6 in pipe, Morris & Tasker, 2d hand.		
Profiling Machine, 2 spindles, Lincoln's make.		
Horizontal Boring Machine, modern style, 40 in. swing,		good as new
Boiler Plate Planer, 15 ft., good order, price low.		

Large assortment of other Tools. Send for Complete List.

68 Cortlandt St., NEW YORK. J. J. McCABE, Successor to E. P. BULLARD'S New York Machinery Warerooms

SOUTH BROOKLYN STEAM ENGINE WORKS,

Successors to WILLIAM A. LIGHTHALL.



VAN BRUNT AND SUMMIT STS. BROOKLYN, N. Y.

New York Office, 69 Wall St.

BUILDERS OF THE Pat. Combined Surface Condenser and Feed Water Heater.

Lighthall Surface Condensers with Cobb's Improvements. Light Weight Brass Condensers a Specialty. Also Feed Water Heaters, Tube Heads, Screw Glands, Packings, &c.

Complete Steam Plants,

Engines, Shafting, Hangers, Pulleys and Boilers.

THE LANE & BODLEY CO., CINCINNATI, O.

THE NORTON DRILLS.

FOR LIGHT, SENSITIVE AND RAPID DRILLING.

1, 2, 3, 4 or more Spindles, Sensitive or Automatic Feed.

To drill from 0 to 1-2 inch holes.

The *Latest* and *Best*; most convenient, sensitive and durable Drill on the market.

Have Balanced Spindles and Balanced Tables.

Write for prices and description, or for Special Machinery.

THE NORTON & JONES *Machine Tool Works,* PLAINVILLE, CONN.

Manufacturers of Machine Tools and Special Machinery.

MACHINERY

For Reducing and Pointing Wire.

ESPECIALLY ADAPTED TO POINTING WIRE RODS AND WIRE FOR DRAWING.

For Machines or Information, address the Manufacturer,

S. W. GOODYEAR, Waterbury, Ct.

STEVENS PATENT RELIABLE DIVIDER. No. 6,

With Thumb Attachments.

Forged from heavy stock, operated with a right and left hand screw. Made with two tension screws, removing any back lash.

3 inches, price per pair $1.75

Ideal and Leader Spring Dividers and Calipers, Ideal Surface Gauges, Depth Gauges, and Fine Machinists' Tools.

☞ *Illustrated catalogue free to all.*

J. STEVENS ARMS & TOOL CO., P. O. Box 231, Chicopee Falls, Mass.

MACHINE TOOLS

BORING AND TURNING MILLS, LATHES, TURRET MACHINES.

BRIDGEPORT MACHINE TOOL WORKS, E. P. BULLARD, PROP'R. BRIDGEPORT, CONN.

THE BALL & WOOD COMPANY,

Owners of Ball Patents and Builders of

IMPROVED AUTOMATIC CUT-OFF ENGINES.

Under the personal supervision of the inventor, F. H. BALL.

SIMPLE ENGINES, COMPOUND ENGINES, TRIPLE EXPANSION ENGINES, for ELECTRIC LIGHTING PLANTS, ELECTRIC RAILWAY PLANTS, MANUFACTURING PLANTS,

And all Purposes requiring close regulation and economy.

Works, Elizabeth, N. J. Office, 15 Cortlandt St., N. Y.

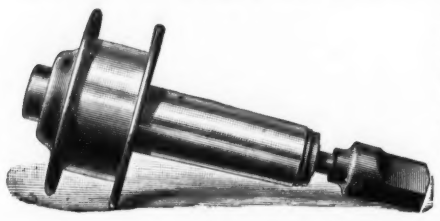
BROWN & SHARPE MFG. CO.,

PROVIDENCE, R. I.

HIGH SPEED MILLING ATTACHMENT

TO THE

No. 1 UNIVERSAL MILLING MACHINE.



This device is of service for light or finishing cuts with end mills, and consists of a small collet or spindle running in a shell that fits the hole in the cone spindle of the machine. It is driven directly from an extra pulley on the countershaft, and thus small mills may be run much faster than the usual speed of the cone spindle.

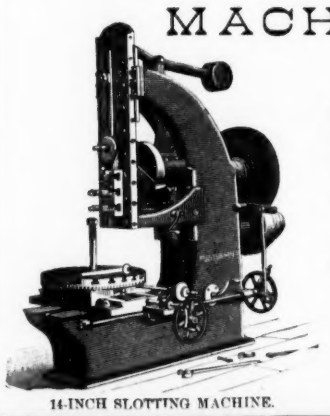
S. A. SMITH, Western Representative,

23 SO. CANAL STREET, CHICAGO, ILL.

NILES TOOL WORKS,

HAMILTON, OHIO.

MACHINE TOOLS.



14-INCH SLOTTING MACHINE.

SLOTTING MACHINES.

In sizes from 6½-inch stroke to 54-inch stroke. Cutter-bar counterbalanced and provided with quick return motion. Feeds are longitudinal, transverse and circular, all automatic.

Special Iron and Steel-working machinery for all classes of machine shops.

Correspondence solicited.

NEW YORK, 136 & 138 LIBERTY ST.
CHICAGO, PHENIX BLDG.
PHILADELPHIA, 705 ARCH ST.
PITTSBURGH, LEWIS BLOCK

GRANES

THE YALE & TOWNE MFG CO.
STAMFORD CONN
NEW YORK CHICAGO PHILA. BOSTON

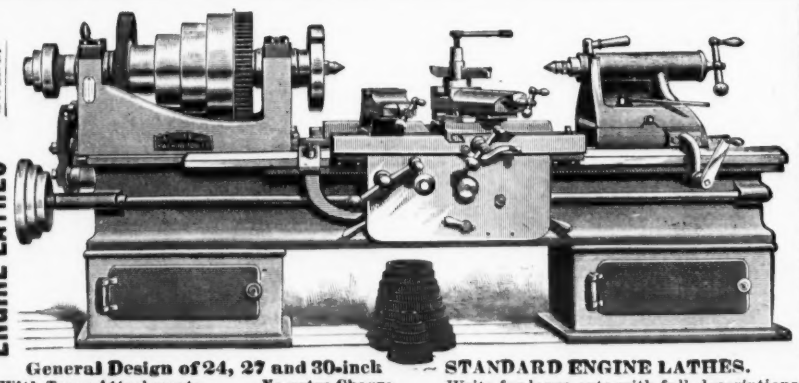
The Original Unvulcanized Packing

CALLED THE STANDARD—As it is the Packing by which all others are compared.

Accept no packing as JENKINS PACKING unless stamped with our "Trade Mark."

JENKINS BROS. 71 JOHN STREET, N. Y. 105 MILK STREET, BOSTON. 21 NORTH FIFTH ST., PHILA. 31 & 33 N. CANAL ST., CHICAGO.

ENGINE LATHES 14 TO 38 INCH SWING.



MACHINE SHOP OUTFITS

General Design of 24, 27 and 30-inch With Taper Attachments. No extra Charge.

THE LODGE & DAVIS MACHINE TOOL CO.,

Works: CINCINNATI, OHIO.

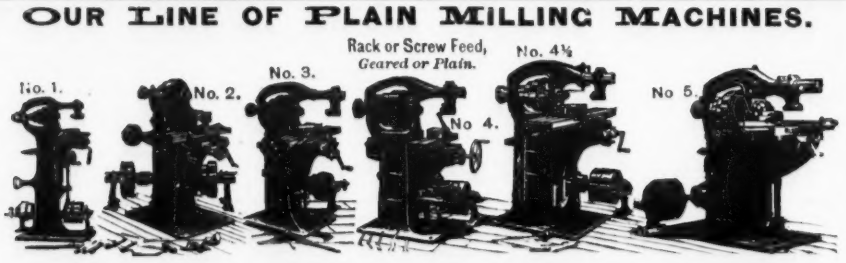
STANDARD ENGINE LATHES.

Write for large cuts with full descriptions.

EASTERN HOUSE, 64 Cortlandt St., N. Y. City.
WESTERN HOUSE, 68 & 70 S. Canal St., Chicago, Ill

See Advertisement on Page 16.

OUR LINE OF PLAIN MILLING MACHINES.



THE GARVIN MACHINE COMPANY,

Manufacturers of, and Dealers in, all kinds of

MACHINERY AND MACHINE TOOLS.

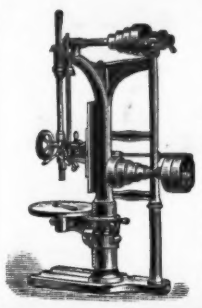
Universal and Plain Milling Machines, Drill Presses, Screw Machines, Hand and Engine Lathes, Planers, Profilers, Chucking Machines,

Gear Cutters, Die and Cutter Grinders, Tapping Machines, Wire-Spring Coilers, Milling Cutters, &c.

Plants for Manufacturers of Sewing Machines & Electrical Goods.

GEAR-CUTTING AND MILLING IN ALL ITS BRANCHES.

Laight & Canal Sts. [Catalogue sent on Application.] NEW YORK.

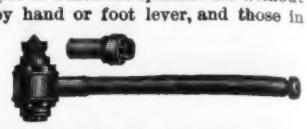


THE PRATT & WHITNEY CO.,

Hartford, Conn.,

MANUFACTURE

Renshaw's Ratchet Drills, Nos. 1 and 3; **Upright Self-Feeding Hand Drilling Machines** for Blacksmiths; **Upright Drilling Machines,** single and multi-spindle, both those in which the spindles are without feed movement and tables are operated by hand or foot lever, and those in which the tables have provision for adjustment, and spindles are fed by hand lever, or by hand wheel, or automatically; also, **Horizontal Drilling Machines,** single and multi-spindle.



WESTERN BRANCH, 100 West Washington St., Chicago, Ills.

THE BILLINGS & SPENCER CO.,

HARTFORD, CONN., U. S. A.

MANUFACTURERS OF

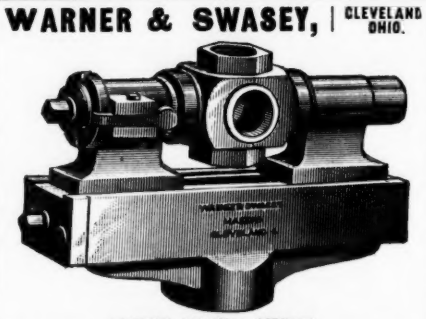
BILLINGS' PATENT BEAM CALIPER.

The construction of the Caliper is such that it protects the scale from wear and abrasion. The scale is divided to 64ths on one side and the other to 100ths of an inch. The graduation is accurate and the finish of the tool is first-class in every respect. Cut represents Caliper one-half size.

Drop Forgings of Bronze, Copper, Iron and Steel of all descriptions.

London House: CHAS. CHURCHILL & CO., Limited, 21 Cross Street, Finsbury, London, E. C., England.

WARNER & SWASEY, CLEVELAND OHIO.



GLOBE VALVE CHUCK.

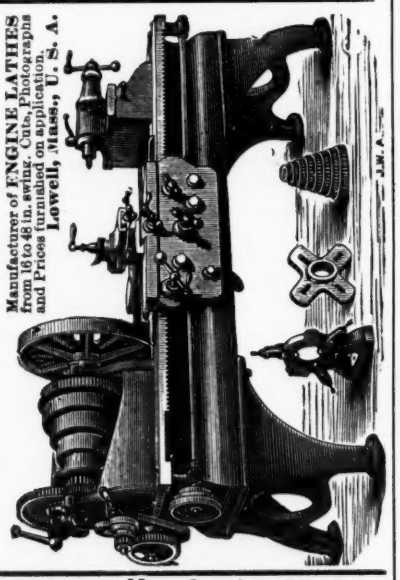
BRASS WORKING MACHINERY

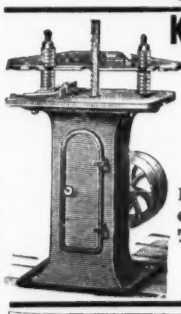
ILLUSTRATED CATALOGUE ON APPLICATION.

GEO. W. FIFIELD,

Manufacturer of ENGINE LATHES from 16 to 48 in. swing. Cuts, Photographs and Prices furnished on application.

Lowell, Mass., U. S. A.





Key-Seating Machines and 20 in. Drills

A SPECIALTY.

SEND FOR LIST OF

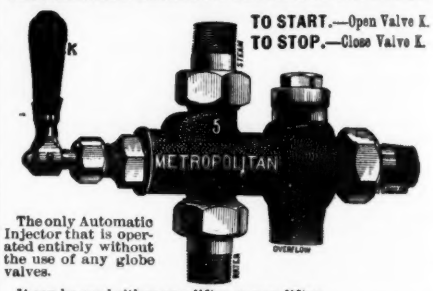
New and Second-Hand

Lathes, Planers, Drills, or anything in Machinists' Tools or Supplies.

W. P. DAVIS,

Rochester, N. Y.

THE METROPOLITAN AUTOMATIC INJECTOR



TO START.—Open Valve K.
TO STOP.—Close Valve K.

The only Automatic Injector that is operated entirely without the use of any globe valves.

It can be used either as a lifter or non-lifter.

It is adopted by the largest Engine Builders, and is for sale by the LARGEST SUPPLY HOUSES IN THE U. S.

Ask your dealer or send to us for circular and prices.

The Hayden & Derby Mfg. Co.,

No. 111 Liberty St., New York.

WESTERN AGENTS:

Marinette Iron Works Co., Chicago, Ill.
Robinson & Cary Co., St. Paul, Minn.
English, Morse & Co., Kansas City, Mo.
J. M. Arthur & Co., Portland, Oregon.

HARTFORD STEAM BOILER INSPECTION AND INSURANCE CO.

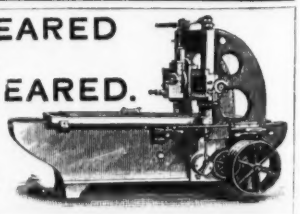
J. M. ALLEN, PRESIDENT.
WM. B. FRANKLIN, VICE-PRESIDENT.
F. B. ALLEN, SECOND VICE-PRESIDENT.
J. B. PIERCE, SECRETARY & TREASURER.

GRANTS GEAR WHEELS and GEAR CUTTING of every kind and all sizes, ready made or made to order. New Treatise on Gears for $1.50. Send for Catalogue or Estimate.

LEXINGTON GEAR WORKS, LEXINGTON, MASS.

PLANERS

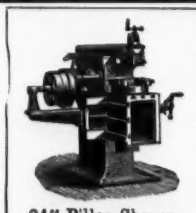
SPUR GEARED AND SPIRAL GEARED.



MANUFACTURED BY

The G. A. GRAY CO.,

479 Sycamore St., CINCINNATI, O.



24" Pillar Shaper.

15" Pillar Shaper.

25" Pillar Shaper.

THE HENDEY MACHINE CO. TORRINGTON, CONN. MANUFACTURERS OF MACHINE TOOLS SEND FOR OUR CATALOGUE.

J. M. CARPENTER PAWTUCKET, R. I.

Manufacturer of TAPS & DIES